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NOTICE.—Index to Volume XI. will be issued with the next number. The price of next week's issue, with Index, will be 2d.

FRIDAY, JULY 8TH, 1892.

The Tower Steady Platform.

THE Admiralty have had one of Mr. Beauchamp Tower's steady platforms fitted on board the gunboat "Bloodhound," for the purpose of carrying a 24in. search-light projector. The use of this apparatus enables a search light or small gun to be held perfectly steady against angular motion on board ship, no matter how violently the vessel may pitch and roll. The platform on which the object to be kept steady is placed, is suspended in gymbals, and is moved relatively to the ship by four hydraulic cylinders, the rams of which press against points fixed to the ship, and thereby govern the motion of the platform. The admission, emission, and pressure of the water in the cylinders are controlled by a rotating wheel or gyroscope, which rapidly revolves in a horizontal plane on a cup-and-ball bearing carried on the lower part of the platform. Water, with a pressure of 100lb. per square in., is forced by a small steam pump through the joints and hollow ring of the gymbals, and thence through a hole in the centre of the ball-bearing to the interior of the gyroscope. From thence it issues in three jets, two of which are tangential in their direction, and give the wheel rapid rotation by their reaction. The third and largest jet issues upward through an axial nozzle. Four small pendulums press by means of bell-crank arms on the rim of the gyroscope in such a way as to cause it to rotate in a truly horizontal plane, and consequently to throw a vertical jet out of the axial nozzle. At a little distance immediately above this nozzle is a circular opening divided into four equal parts by radial partitions, each of which communicates with one of the hydraulic cylinders. Upon this group of openings the axial jet plays. Provided the jet is central with them, the whole receive the same amount of water from it, and the pressure in the cylinders remains equal; but if, through the platform not being concentric with the openings, one gets more of the jet than the others, and the cylinder connected with it presses harder than the rest, the platform is canted until the openings and jet are concentric and the platform assumes a horizontal position. The desirability of mounting search lights on small craft for the protection of a fleet at anchor against torpedo-boat attack at night has long been recognised, but the objection to their employment, that the least sea causes them to knock about so that the search light cannot be used effectively, has never hitherto been overcome; and it is contended in favour of the Tower apparatus that it will hold the narrow ray from a search light perfectly steady even in a steam launch which is rolling considerably.

An Electric Port and Masthead Light.

A LAMP comprising an electric port, starboard and masthead light combined, has been brought out. It is fitted with very powerful cut-glass lenses and polished reflectors, the illumination being provided by three incandescent lamps of 16C.P. There are two switches; one controls the port and starboard lights, and the other the masthead light. The latter can be used as a riding light when the launch is at anchor. The current is taken from the ordinary lamp circuit in connection with the incandescent lamps in the cabin. The outside casings of the lamps, which are of black enamel, are 10in. diameter, 8in. in height, the masthead light being 8in. by 5in. The latter is removable when the launch is running in daylight. The whole arrangement is very sightly, and the current can be switched on at will; besides this, the combination has several advantages over the old method of having three separate oil lamps, which are objectionable on board an electric launch, for cleanliness is one of the advantages of electrical propulsion. On the trial of one of these lamps excellent results were obtained, the lights being visible a mile away. Four of these lamps are being made for use on electric launches. One is now fixed on the cabin top of the "Glow-worm," which runs at 9½ miles an hour, a speed claimed to be the highest attained by any electric launch on the Thames.

The Scotch Shipbuilding Trade.

THERE are few interesting features in the Scotch shipbuilding record for June. The production is much above the average, but the contracts, representing, as they do, a greater total than usual, reduce its effect on the work in hand. The most important contract of the month came to the Clyde, a prominent firm receiving an order from the Royal Mail Steam Packet Company for two passenger steamers of about 6000 tons each. Two important contracts were secured by the Grangemouth Dockyard Company. A high-speed steamer for passenger service is to be built for Hungarian owners, and a three-masted steel barquentine of 500 tons for Messrs. John Sutcliffe and Sons, Grimsby. The Ailsa Company, Troon, are to build a small steel screw steamer for the British India Steam Navigation Company Limited. A small launch of 17 tons and 70H.P. is to be constructed for foreign owners by Messrs. Ritchie, Graham and Milne, Craigton. Messrs. Lobnitz and Co., Renfrew, booked an order for a quantity of their patent rock-cutting plant. Messrs. Alexander Hall and Co., Aberdeen, contracted to build two vessels—one a steam trawler of the usual type, and the other a steam line fishing boat, 86ft. by 18½ft. by 9ft. The latter, which is to be of steel, will be the first of her type built on the Dee. Scotch shipbuilders launched 27 vessels, aggregating 38,426 tons, of which 16, representing 15,189 tons, were steamers, and 11, measuring 23,237 tons, sailing vessels. To the total the Clyde contributed 12 steamers of 11,322 tons, and 9 sailing vessels of 21,287 tons; the Forth 2 steamers of 3015 tons, and 2 sailing vessels of 1950 tons; the Tay a steamer of 580 tons; and the Dee a steamer of 272 tons.

Electric Traction on Tramways.

INCREASING interest was manifested in electricity as a motive power for tramways at the meeting held last week by the Tramways Institute of Great Britain and Ireland, when the papers announced in our issue of the 24th ult. were read and discussed. In the paper referring to the City and South London Electric Railway, Mr. Grindle pointed out that during the whole of the eighteen months that the line had been in operation no accident or stoppage of the generating dynamos had occurred. Slight delays had occasionally taken place with the locomotives, but they had been traced to the unexpected load and strain put upon the latter. Notwithstanding this, the record of work done by the locomotives compared very favourably with that accomplished by steam locomotives, and the only conclusion which could be drawn from the working of the line was that from an electrical point of view the railway had been very successful. As far as storage battery traction was concerned, Mr. Epstein gave some estimates concerning his accumulator as applied to tramcar propulsion, and also as regards some experiments undertaken to test its efficiency. The figures given showed, according to the author, that accumulator traction was much cheaper than that of horse haulage, and that the former would allow of much better commercial results being obtained. The cost of maintaining his accumulator would, from the estimate set forth, not exceed one penny per car mile; and he was prepared to stand by that figure. Mr. Jarman presented the results of working with his system for six months at Croydon. According to his experience, the vulcanised fibre teeth which he had adopted in the gearing wheels, were not adapted for every-day work, and hard gun metal was therefore substituted. Phosphor-bronze wheels gave better results than the mortice wheels made of cast iron for the gearing. The motor had worked well, whilst his improved battery, which he had referred to at the last annual meeting, had fulfilled the expectations predicted on that occasion. He calculated that the cost with his system would only be 4½d. per car mile, and concluded that the accumulator car would take a firm footing upon the tramlines. The papers and discussions thereon attracted considerable attention, and they will doubtless tend to develop electric traction in this country.

Launch of H.M.S. "St. George."

ON the 23rd ult. the first-class protected cruiser, "St. George," was launched from Messrs. Earle's shipbuilding yard at Hull. The dimensions of the "St. George" are:—Length between perpendiculars, 360ft.; breadth extreme, 60ft. 8in.; draught of water, 24ft. 9in. She will be propelled by twin-screw engines of 12,000I.H.P., supplied by four very large double-ended main boilers and one auxiliary boiler, and is expected to attain a speed of 20 knots. In the machinery space the cylinders are protected by armour 6in. thick (compound), fitted between the protective and main decks over the extent of the engine-room. A protective deck, 2½in. thick, extends over the greater portion of the length, tapering to 2in. at the ends, and on the slope of the deck the maximum thickness is 5in. The conning tower is of 12in. compound armour, with armoured communication tubes 7in. thick. Between the protective and main decks ready for use magazines of 3in. steel are fitted for supplying the casemate guns and 6in. guns on the upper deck. The double bottom in the machinery space is divided into 27 watertight compartments, but the double bottom is virtually extended nearly throughout the length of the ship by means of the flats to magazines, etc. Her armament consists of two 9·2in. breech-loading guns on centre pivot mountings, fitted on the upper deck, and protected by shields; six 6in. quick-firing guns on centre pivot mountings, fitted on the upper deck and protected by shields 3in. thick; four 6in. quick-firing guns on centre pivot mountings, fitted in casemates on the main deck, and protected by 6in. compound armour in the front and 2in. steel plating at the rear; twelve 6-pounder quick-firing guns, distributed as follows: Two on forward deck shelter, two on after deck shelter, four on upper deck, two on main deck forward, and two on main deck aft; five 3-pounder quick-firing guns, seven 9·45 5-barrel Nordenfeldts, and torpedo tubes.

Oliver Evans and the Locomotive.

MOST students of mechanics and mechanism in this country will doubtless have encountered the name of Oliver Evans in connection with an arrangement of levers for producing a straight-line movement, but they will doubtless be surprised to learn that, according to American opinion, he is entitled to undying fame as the progenitor of the locomotive. Thus we are gravely informed that "the two essentials of the locomotive—the high-pressure, non-condensing engine and the multitubular boiler—were both the inventions of Americans, the first of Oliver Evans and the second of Nathan Read, of Salem, Mass. These men were the grandfathers, so to speak, of the locomotive, and Trevithick, an Englishman, not George Stephenson, was its father. Trevithick, Blenkinsop, and Hedley all antedated Stephenson, but without the high-pressure engine and the single and double-flue boilers of Oliver Evans, drawings and plans of which had been taken to England in 1796, Trevithick would in all probability have never been known outside of Cornwall. His use of the Evans single-flue boiler caused it to be known as the Cornish boiler, while the Evans double-flue boiler became the Lancashire boiler in the same way." This will no doubt be news to engineers, at any rate to many of those on this side of the water.

Air Moistening in Spinning and Weaving Mills.*

THE favourable influence of damp air in the operations of spinning and weaving is generally recognised, and various methods for moistening the air artificially have been advocated. The one here described is that invented by Körting Brothers, of Paris.

The essential part of the apparatus is a spiral tuyère, which impresses on a jet of water forced through it a rotary movement that causes it to emerge in the form of an inverted cone, and divided into fine spray. This cone of water carries with it a great part of the surrounding air, an effect which is increased by the form of the casing, which presents a series of cones increasing in diameter one above the other. A sieve and a set of louvre blades facing the jet separate all the drops of water, so that nothing but saturated air passes into the room. A small pump delivers the water at 85lb. pressure, and pulverises 22 gallons per hour in each apparatus, of which about 21 gallons is returned to a tank to be filtered and repumped.

The apparatus can be regulated by an admission valve that varies the pressure, or by varying the angle of the louvre blades. As there are no moving parts, the apparatus costs little to maintain, and lasts indefinitely, while it is very cheap in first cost compared with the work it does.

ANOTHER new indiarubber substitute is described. It consists of Manilla gum, tempered with benzene, to which an addition of 2 per cent. of Auvergne bitumen, also mixed with benzene, is added. These are thoroughly blended, and after 5 per cent. of rosin oil has been added, a product is obtained having, it is said, the suppleness, elasticity, solidity, and durability of the best rubbers.

* Inst. C.E.; Foreign Abstracts.

Hydraulic Machinery.—VII.

Hydraulic Cranes.—In the hydraulic crane we have one of the simplest, and at the same time one of the most useful applications of hydraulic power. Figs. 16 and 17 show details of the lifting and turning cylinders of hydraulic cranes. The cylinders are of cast iron, fitted with a cast-iron ram, and having a stuffing box and gland for hemp packing to prevent leakage. The rams are fitted with a crosshead, carrying multiplying sheaves on the reduplication system, as in pulley blocks. The moving block is represented by the crosshead on the ram, and the fixed block by the sheave frame attached to the bottom of the cylinder. In the lifting cylinder there are two sheaves in the crosshead and one in the sheave frame, the multiplying power being 4 to 1—*i.e.*, for every 1ft. moved by the ram the load will be lifted 4ft. In the turning cylinders there is only a single sheave in the crosshead—*i.e.*, 2 to 1 multiplying power. The turning is accomplished by two cylinders, the chain being fixed at A, passed over the sheave in the crosshead round the cupped turning drum, over the second sheave in crosshead of ram D, to the fast end at B. If the ram D is forced out the crane turns in the direction of the arrow D; if the ram C is forced out, in the direction of the arrow C.

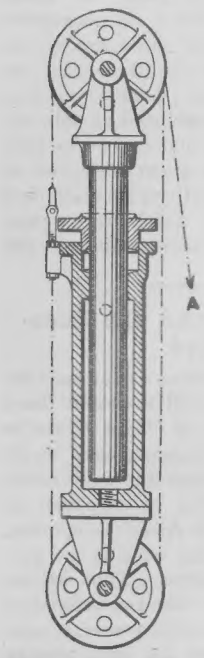

Fig. 16.

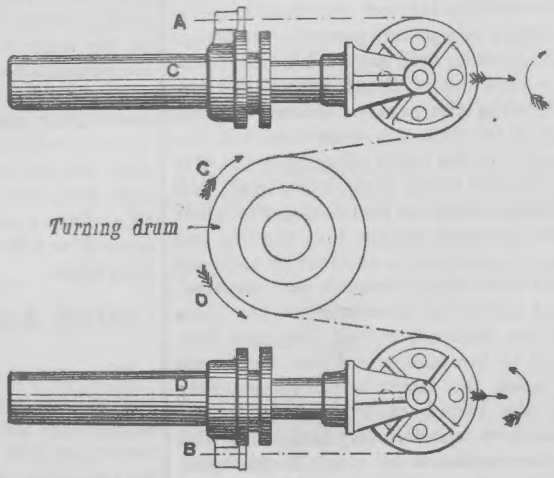

Fig. 17.

Figs. 18 and 19 show two arrangements of cranes in common use. In Fig. 18 the lifting cylinder acts also as the pillar. The ram has a multiplying power of 2 to 1, and the blocks A, 3 to 1, giving a total multiplying power of 6 to 1. It is suitable for loads up to two tons. The jib and stays are of wrought iron, the former being built up of plates and angles; the turning cylinders are placed at the foot of the pillar, and are arranged to give the crane 1⅓ revolution in either direction. The valves are placed on a platform in the foundations, and are worked by means of levers passing through slots in the cover plates, and so arranged that the levers can be unshipped when not in use.

Fig. 19 shows a platform crane. The pillar in this case is of wrought iron, and the lifting cylinder is placed within and between the two sides of it. The other details are similar to Fig. 18.

(To be continued.)

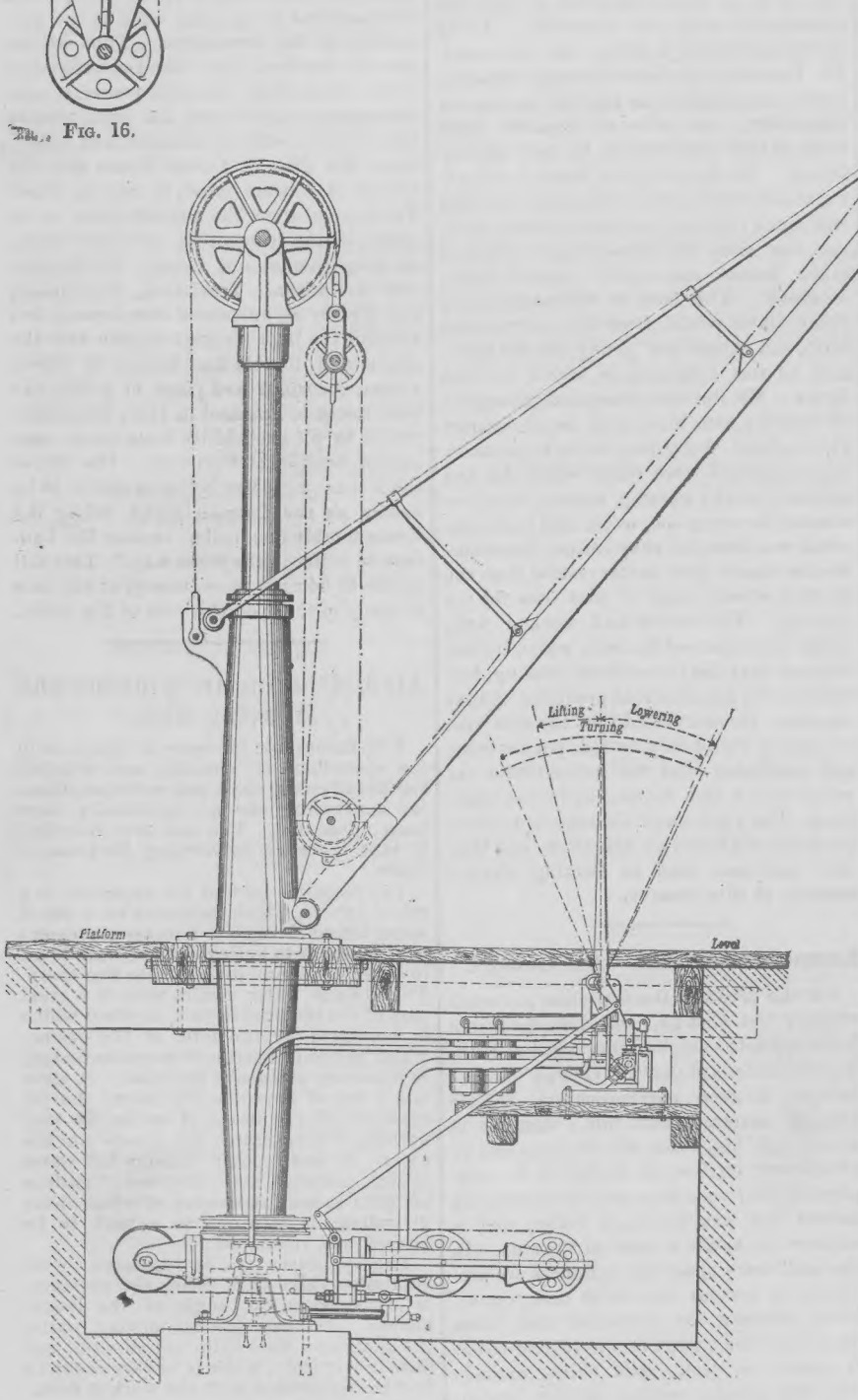

Fig. 18.

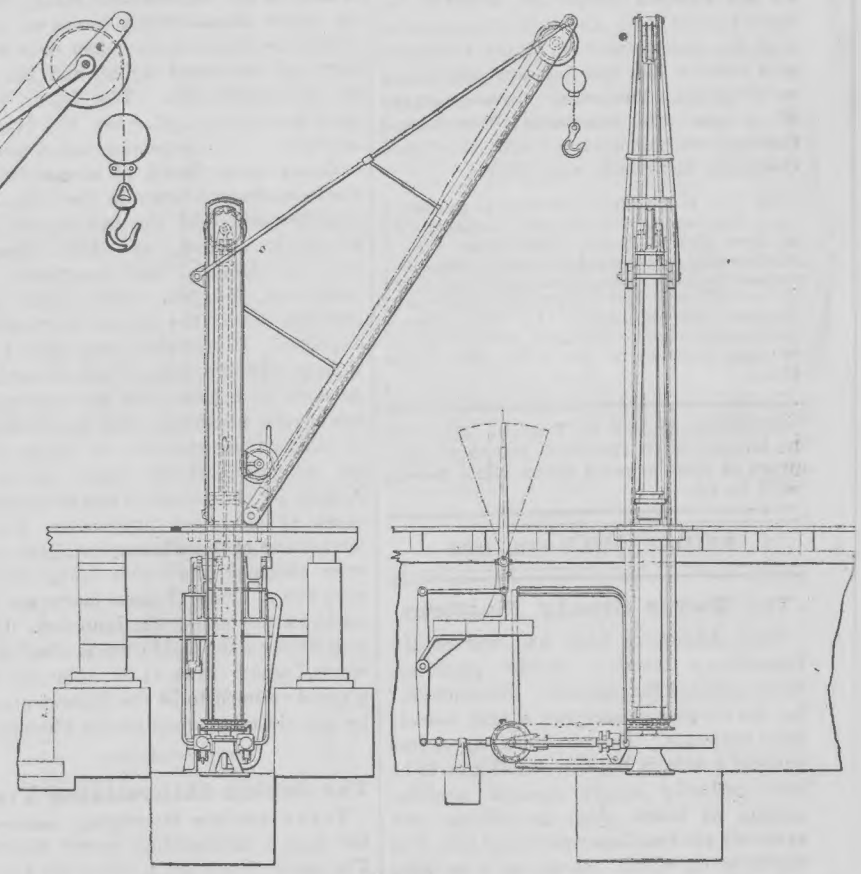

Fig. 19.

The Examination of Iron and Steel by Electrolysis.

Electrolytic methods continue to find favour with those who have occasion to examine the character of the metals and to report upon them. The following process is a new one, and is recommended by Messrs. T. M. Drown and A. G. McKenna in the "Technology Quarterly":—Dissolve 5 or 10grms. of a sample of iron or steel in sulphuric acid, evaporate until white fumes begin to come off, add water and heat until all the iron is in solution; filter off silica and carbon and wash with water acidulated with sulphuric acid. Make the filtrate nearly neutral with ammonia, and add to the beaker in which the electrolysis is to be made about 100 times as much mercury as the weight of metal first taken. The bulk of the solution should be from 300 to 500cc. Pass through a current of about 2 ampères over night, in the morning test for iron, and if necessary continue the electrolysis after adding enough ammonia to neutralise the acid set free. Finally, remove the solution from the beaker with a pipette while the current is passing. When as much has been removed without breaking the current, add water, and continue the operation until the acid has been so far diluted that there is no danger of dissolving iron from the mercury. Take the anode out and wash the mercury. After filtering to remove any flakes of manganese dioxide, add sodium phosphate in excess, and 10grms. of sodium acetate. Make nearly neutral with ammonia and boil for 40min. The precipitate of aluminium phosphate is then filtered off, ignited and weighed: thus the aluminium present may be determined.

Fuel Gas.*

Of the three methods for converting coal into gas for fuel—namely, by natural or forced draught without steam, by forced draught with steam, and by steam and air alternately, resulting in the generation of producer gas, semi-water gas, and water gas respectively,—semi-water gas contains from 80 to 85 per cent. of the heating value of coal, and is the cheapest gas if supplied within a reasonable distance from the place of production.

Producer gas must be burnt hot as it issues from the producer to be advantageous. Water gas contains only about two-fifths of the heating value of the coal from which it is produced, and is, in itself, the most expensive of the three systems. Not the least of the advantages which semi-water gas or "steam-jet" producer gas, as it is sometimes called, possesses over water or coal, is the ease and simplicity of its production. Its production is automatic, and it can be made in quantities varying from 500 cubic ft. upwards per hour. The paper contains detailed calculations of heat produced and heat expended on the three systems.

Mr. Kitson has designed a producer of semi-water gas now in use in the Körting gas engine for the production of power. The engine supplies power to a dynamo. The battery furnishes current for a number of glow lamps, and occasionally for a small electric motor. The producer consists essentially of a cylindrical shell of boiler plate lined with firebrick. The internal diameter of the brickwork is 21in., and the height from the grate to the top of the furnace is 3½ft. The grate is connected at one side with a steam and air injector, and on the other side with a gas-supply pipe. It is surrounded by a cast-iron ashpit. A small reservoir or boiler is placed at one side, connected with which are two coils contained in the brickwork, the lower of which supplies steam, and the upper one of which superheats it. Air channels are formed in the brickwork, arranged spirally, through which air is drawn by the injector and heated before mixing with the steam. The grate is provided with mechanism giving it a rotary and up-and-down movement to break up clinker or caking soft coal. 500 cubic ft. of gas per hour can be produced from 6lb. or 7lb. of coal.

As a general result of experimental tests of semi-water gas with Körting gas engines of from 2H.P. to 18H.P., with a consumption of 85 cubic ft., 1 actual H.P. by break test is developed, equivalent to 1¼lb. of coal per H.P. per hour. The author is of opinion that the gas producer and gas engine must eventually supplant steam for at least small uses. He deduces from his experiments:—(1) That it is decidedly advantageous to clear the cylinder entirely of the exploded products before taking in a fresh charge; (2) that a higher degree of compression than that ordinarily used with illuminating gas is beneficial; (3) that sufficient time should be allowed to enable the gas and air to intermingle in the exact proportions for combustion before ignition.

* Inst. C.E.: Foreign Abstracts.

There was launched from the yard of Messrs. Ramage and Ferguson, Leith, on the 27th ult., a large steel steam yacht, built to the order of the King of Siam. The dimensions are:—Length, 275ft.; breadth, 40ft.; depth, 20ft.; tonnage, 260. The yacht—which is more like an armed cruiser—has a ram projecting several feet from the bow. She will carry 15 guns, of various calibre, the largest of which will be mounted on turrets, and two powerful search lights will also be carried.

The Design and Construction of Stationary Engines.—XXXI.

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In the case of winding, hauling, and similar engines, which are required to run in either direction at any time, a common form of slide is that shown in Fig. 149, which consists of two pairs of top and bottom bars, bolted together and fixed to bedplate by through bolts. Sometimes the bottom slide is cast as part of the bedplate, with the top bar removable. This form of slide has been very extensively used, and it has some merits to recommend it. Fig. 149 gives the dimensions for the guides of an engine having cylinder 15in. diameter by 30in. stroke.

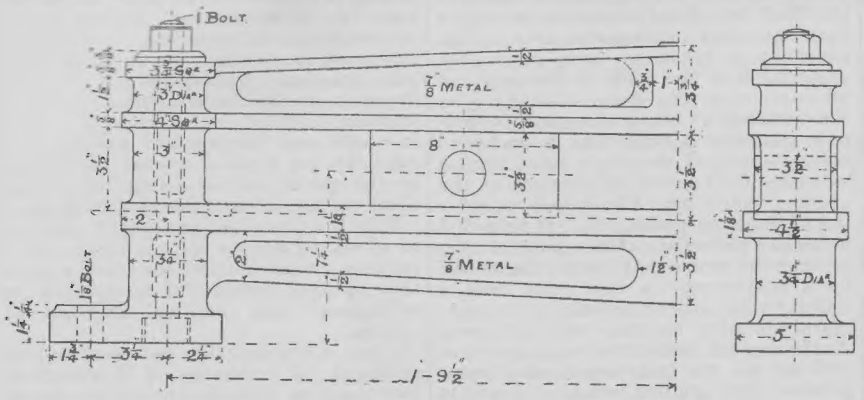

Fig. 149.

Fig. 150 shows the guides for a winding engine, cylinder 18in. diameter by 42in. stroke. The bottom slide, it will be seen, is cast with the bedplate, the top bar being held by through bolts passed up from below.

Fig. 151 is a similar guide for an engine having a cylinder 12in. diameter by 24in. stroke. The top bars have cast at their ends, pedestals and brasses for carrying the rocking shaft which works the slide valve, which in this engine is arranged on the top of the cylinder. This used to be a common arrangement for horizontal engines which required to be reversed occasionally by hand, and yet had only one eccentric; the eccentric-rod end being formed with a "gab," which could be raised out of connection with the valve spindle and the slide valve, worked by means of a hand lever, and the engine reversed in the required direction.

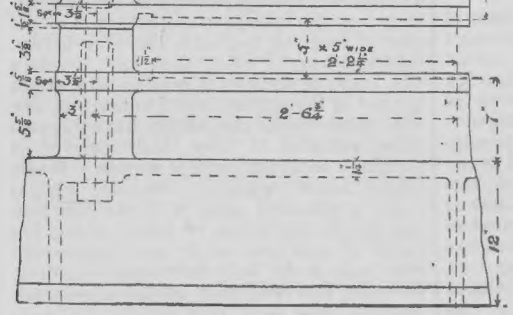

Fig. 150.

Fig. 152 shows a form of slide mostly employed in marine engines and vertical land engines of similar design. The slide forms part of the back standard, with cover plates similar in arrangement to those of Fig. 144.

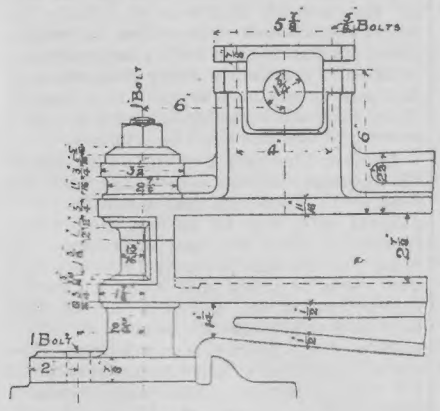

Fig. 151.

Fig. 153 is the type of slide bar as used for powerful marine engines for war vessels. The slide bar is of wrought iron or steel of rectangular section, having shallow diagonal grooves cut across the top face to retain the lubricant. The crosshead, it will be seen, can be adjusted top and bottom, the slippers being filled with white metal. Bars of similar design, but in pairs, are often used in portable engines for the sake of lightness. Slides constructed on this principle are capable of fairly accurate calculation. They may be treated as rectangular beams supported at the ends and loaded in the middle. Although such bars are bolted rigidly at the ends, they cannot be so stiff and rigid as to be considered fixed at the ends, and it is safer to assume them as supported only.

The slide bar in this case should be designed for rigidity. The effective length of the bar is equal to the stroke of the engine plus the length of crosshead or slipper, plus a small amount at each end for clearance. The breadth of the guide being constant, the depth will be variable, being greatest at the middle. The maximum load on the guide is found as already explained, being the reaction on the guide of the stress on the connecting rod. The cross section of the bar is rectangular, and the shape of the bar in elevation for uniform strength is that of a pair of parabolas, with their vertices at the end and meeting at the centre.

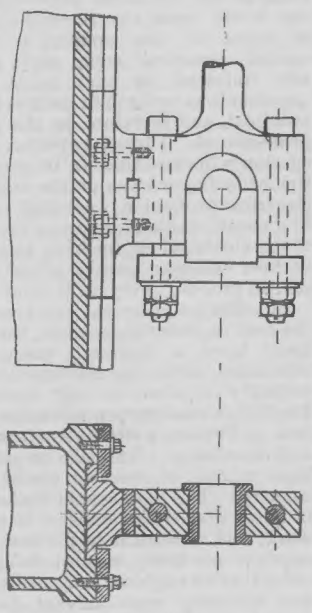

Fig. 152.

The greatest allowable deflection is $\frac{1}{100}$in. The formula for deflection of a beam loaded at the centre and supported at the ends is—

$$D = \frac{1}{100} = \frac{1}{48}\cdot\frac{P.l^3}{EI}$$

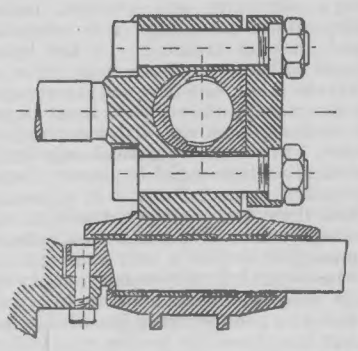

Fig. 153.

Where P = pressure on guide in lb., l = length of beam or guide in inches between supports, E = modulus of elasticity = 28,000,000 for wrought iron and steel and 18,000,000 for cast iron, I = moment of inertia of cross section of guide = $\frac{bh^3}{12}$ for a rectangle, b = breadth of beam in inches, h = height or depth of beam in inches.

We may write it in terms of the steam pressure and diameter of cylinder thus:—

$$\frac{1}{100} = \frac{1}{48}\cdot\frac{\frac{\pi}{4}D^2p_1}{\sqrt{n^2-1}}\cdot\frac{l^2}{E}\cdot\frac{12}{bh^2}.$$ Let f = factor of safety. We may write the formula thus:—

$$h = \frac{l}{125}\sqrt[3]{\frac{D^2p_1}{fb\sqrt{n^2-1}}}$$

for wrought-iron or steel guide, and

$$h = \frac{l}{97}\sqrt[3]{\frac{D^2p_1}{fb\sqrt{n^2-1}}}$$

for cast-iron guide

(To be continued.)

Testing and Analysis of Iron and Steel.—X.

By Messrs. Leadbeater and Hodgson (*Analytical Chemists*).

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Carbon exists in cast iron in two distinct forms, and it is the predominance more or less of one form over the other which gives the several varieties of iron—viz., grey, white and mottled. The two forms are known as, first, graphitic carbon; second, combined carbon; and it is these constituents which impart to cast iron, wrought iron, and steel their characteristic properties.

The maximum amount of total carbon—that is, graphite + combined carbon—is in pig iron under 5 per cent., except where any quantity of manganese is present, as in spiegeleisen or ferro-manganese, when it is higher; 80 per cent. ferro-manganese containing as much as 6·8 per cent. of carbon, wholly in the combined state.

It is not often that less than 2·5 per cent. of total carbon is found in pig iron, except when silicon is very high, as in ferro-silicon, which, with 12 per cent. Si, contains about 1·5 per cent. of total carbon, and in this case it is almost all in the graphitic state.

For ordinary foundry pig iron the amount of carbon varies between 3 and 3·8 per cent.

Combined carbon is a definite chemical compound of carbon with iron, a carbide of iron, of the formula Fe_3C, and therefore composed of 93 33 per cent. of iron and 6·67 per cent. of carbon, while graphitic carbon is simply free carbon interspersed throughout the mass—a mechanical mixture with the iron, but not a chemical combination. The relative amount of the two conditions of carbon greatly depends upon the mechanical treatment which it has received, the rate of cooling, etc.

The relative proportions may also be altered by variation in the proportions of the other elements present; thus an increase of manganese, sulphur, or phosphorus is followed by an increase of combined carbon, while with an increase of silicon a contrary result is produced.

Thus a given variety of pig iron may be made hard or soft at will, to suit the various purposes of the founder, when its chemical composition is known.

Grey iron contains a large proportion of graphite, while in white irons the carbon is almost wholly in the combined state; mottled irons being intermediate between the two extremes, contain varying proportions of carbon in both conditions.

In the determination of carbon the usual method is to first find the total percentage, then the amount of combined carbon separately, and finally to obtain the amount of graphite by subtraction.

The best methods for the determination of total carbon are the combustion methods, either moist or dry, the latter being probably the more accurate one.

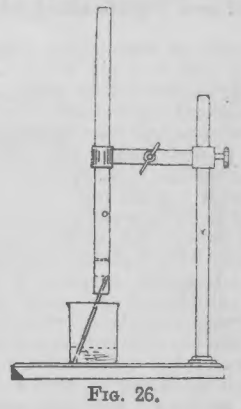

Fig. 26.

In either of the two methods a considerable amount of special apparatus will be required, on the carefully fitting up of which depends in a great measure the accuracy of the determination.

DETERMINATION OF TOTAL CARBON BY DRY COMBUSTION.

Preparation of Solutions: Solution No. 1.—300grms. of copper chloride [$CuCl_2$] are taken, dissolved in 1 litre of water, and allowed to stand a little time. A strong solution of sodium hydrate [NaHO] is then added, drop by drop, until a slight precipitate begins to form; the solution is then well stirred with a glass rod, when, if the precipitate redissolves, a little more sodium hydrate solution is added, and the operation repeated until the slight trace of precipitate remains upon stirring. The beaker is set aside for a couple of days, to allow the precipitate to subside. The solution is then filtered through an asbestos filter paper two or three times and retained in a closely stoppered bottle.

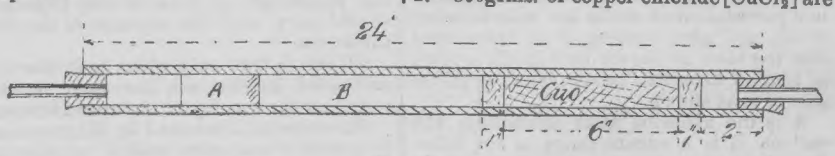

Fig. 27.

No. 2 Solution.—300grms. of copper chloride and 150grms. of sodium chloride [NaCl] are dissolved in 1 litre of water and 100 cubic centimetres of hydrochloric acid added.

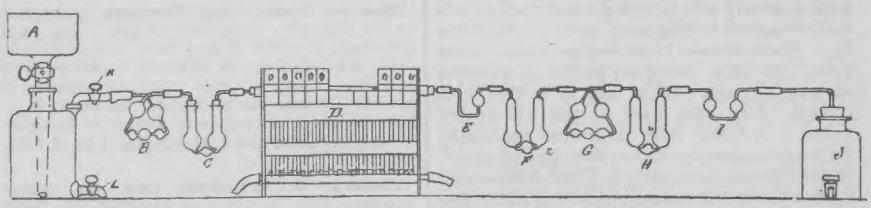

Fig. 28.

1grm. of the pig iron is weighed out into a clean Bohemian beaker and covered with a clock glass. It is then treated with 25cc. of No. 1 solution in the cold, and allowed to stand for an hour or two. At the end of this time another 5cc. of solution is added and the whole gently warmed and allowed to thoroughly subside. This solution has the property of dissolving out all the iron in the form of chloride, while at the same time an equivalent quantity of copper is precipitated.

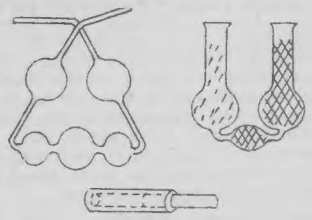

Fig. 29.

The iron, which previously existed as carbide, is also taken up, and copper precipitated in its place. Thus we now have all the carbon originally contained in the iron existing in a free state, but mechanically mixed with the precipitated copper.

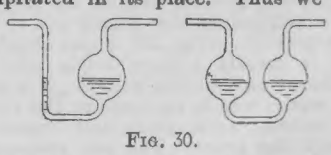

Fig. 30.

Formerly it was the practice to ignite this mixture at once, but it was found that very little carbon was burnt until the copper had become completely oxidised, and thus the combustion was prolonged. It is best, therefore, to first remove the copper and then to ignite the carbon alone.

Solution No. 2 is used to effect this. The liquid remaining in the beaker above the carbon, and precipitated copper previously left to subside, is drained off a

completely as possible, and 50cc. of No. 2 solution added in its place, the whole being warmed gently until the copper is dissolved out and only carbon, silicon, etc., is left behind. When solution is complete, the beaker is allowed to stand a little time previously to filtering, which must be done through an asbestos plug, prepared as follows:—

A piece of hard glass combustion tube is taken, about 2ft. long by $\frac{7}{8}$in. bore, and supported on a burette stand, as shown in Fig 26.

The tube is thoroughly cleaned and rinsed out with distilled water, and a plug of recently ignited asbestos fibre about 2in. long is rammed tight at about 4in. from the bottom with a glass stirring rod. A beaker is then placed below, and the plug of asbestos, which is supported from the bottom with a glass rod.

A little distilled water is passed through, and then the solution, which requires filtering. When all the liquid is out of the beaker, hot water is added, together with a little dilute hydrochloric acid, and the whole passed through the tube, the precipitate being washed into the tube with the water bottle. The sides of the tube are then washed down with hot water in such a manner as to leave no carbon adhering to the walls, all being brought to the top of the asbestos plug. The glass rod is removed and the tube allowed to drain thoroughly, but care must be taken to exclude dust. When drop dry it is gently warmed with a Bunsen burner, and a stream of dry air circulated through it by a filter pump or aspirator, and continued until the plug is thoroughly dry.

Some copper oxide is taken and ignited in a porcelain dish while the tube is being dried, and after cooling it is introduced into the tube as shown in Fig. 27, a plug, as ignited asbestos, being placed on either side of it as shown.

A is the asbestos filter containing the carbon, B is a vacant space in the tube. Two indiarubber corks containing short glass tubes are then inserted and the whole placed in the combustion furnace described below. A supply of oxygen gas will be required, and a glass gasholder must be filled with the same, which may either be made direct or purchased compressed in steel cylinders.

The following train of apparatus will now be required, and it may be fitted up while the operations previously described are in progress.

A (Fig. 28) is the gasholder, the bottom part of which must be completely filled with water. The funnel and stop-cocks are then inserted and oxygen passed in through the cock K, the water at the same time being allowed to run out at the bottom cock L. The potash bulbs B are next nearly filled with a strong solution of potassium hydrate and attached to the neck of the gasholder by a short piece of thick walled indiarubber tube, the bulbs being supported on a proper stand and each end of the tube tied with string. The first part of the absorption tubes c is filled with pummice saturated with potassium hydrate solution and dried, while the second part is filled with small lumps of calcium chloride [$CaCl_2$], the indiarubber corks and glass tubes are quickly inserted and the apparatus attached by rubber tube to the free end of the potash bulbs, as shown, the free end of the last combination being closed with a short piece of rubber tube stopped at one end with a piece of glass rod until it is ready to be attached to the combustion tube. Fig. 29 gives an enlarged view of these two bulbs, and also the stopper.

The bulbs G and H (Fig. 28) at the other end of the apparatus are exactly similar, and are to be fitted up in the same way. E is a glass tube bent as shown in Fig. 30 and filled up to the mark indicated with a solution of chromic acid in sulphuric acid. I is a similar tube, but with two bulbs, which are filled up to the mark (see Fig. 30) with strong sulphuric acid.

These are now all coupled up together with strong indiarubber tubing and string. The aspirator J (Fig. 28) is also attached. This is merely a large bottle with an additional neck at the bottom; it is filled with water, which, on opening the tap at the bottom, runs away and draws air through the tubes. The two systems of apparatus are now joined, one to each end of the combustion tube, which was previously placed in the furnace. The furnace, which is heated by gas, will be described in the next article.

(To be continued.)

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On Calculating Helical Springs.*

THE customary formulas for helical springs are:—

$$P = \frac{S\pi}{16} \times \frac{D^3}{R} \quad \ldots\ldots\ldots\ldots(1),$$

$$\text{and } F = \frac{32}{\pi} \times \frac{PRL}{GD^4} \quad \ldots\ldots\ldots\ldots(2),$$

in which—

P = maximum load;
S = stress;
D = diameter of wire;
R = radius C to C of coil;
F = total deflection of coil from free state to solid compression;
L = length of wire in coil;
G = ² modulus of elasticity;
H = solid height, and P_1 the load at a certain height greater than H.

To use formula (2) L and P must be known; P is found by (1)—

$$L = \frac{2\pi RH}{D} \quad \ldots\ldots\ldots\ldots (3).$$

The calculation of a spring is difficult if one coil will not suffice, and it is impossible, as a rule, to exceed a certain coil diameter or a certain diameter of wire, and perhaps a second or third coil becomes necessary.

For the second coil the symbols above become p, s, d, r, f, l, g, h, and p_1. Here necessarily h=H, f=F, s=S, and g=G. In each case the length of wire should also be equal in each coil or l=L, so that $\frac{R}{D} = \frac{r}{d}$; the coil-radii being proportional to their wire thickness, which implies that the proportion of load of the two coils should vary with the squares of the wire thickness.

All this is true only when both the free and solid heights are the same in each coil, and the quality of material identical.

The paper is illustrated by diagrams and by practical examples worked out showing the application of the formula on the basis of the above laws.

* Inst. C.E.: Foreign Abstracts

Shipbuilding Notes.

There was launched on the 27th ult., from the yard of Mr. J. Gilmour, Irvine, a small steamer, to carry 90 tons. She is 85ft. over all, 19ft. beam, and 8ft. depth of hold. Messrs. Muir and Houston, of Glasgow, are to supply the engines.

Messrs. Barclay, Curle and Co. Limited. of Whiteinch, launched from their yard, on the 27th ult., a four-masted steel sailing barque of 2500 tons register, built to the order of Messrs. Eyre, Evans and Co., of Liverpool. The dimensions are:—Length, 310ft.; breadth, 43ft. 10in.; depth, 24ft. 5in.

Messrs. Mackie and Thomson launched on the 27th ult., from their shipbuilding yard at Govan, the first of two steel sailing vessels they are building for Messrs. Andrew Weir and Co., Glasgow. Her carrying capacity is about 4480 tons, on a register of about 2637, her principal dimensions being:—Length, 325ft.; breadth, 43ft.; and depth of hold, 24ft. 6in.

Messrs. S. M'Knight and Co., shipbuilders, Ayr, launched on the 28th ult., from their yard, a steel screw steamer. The dimensions are:—Length between perpendiculars, 167ft.; breadth, 26ft.; depth of hold, 11ft. 9in.; deadweight capacity, 600 tons. The vessel is fitted with water ballast, and is designed to attain a speed of 12 knots. The engines will be supplied by Messrs. Muir and Houston, Glasgow.

Messrs. Napier, Shanks and Bell, Yoker, launched, on the 29th ult., the "Bosphorus No. 42," the second of two handsome paddle-steamers being built by them for the "Chirket-i-Hairie," Constantinople, and intended for passenger service on the Bosphorus. The dimensions are:—Length, 160ft.; breadth, 20ft.; depth, 9ft. 6in. The engines are of the oscillating surface-condensing type, constructed by Messrs. David Rowan and Son.

The steam yacht "Fauvette." 415 tons, built by Messrs. Ramage and Ferguson Limited, Leith, and owned by M. E. A. Perignon, Paris, went on her trial trip on the 30th ult., when the speed on the measured mile was on the mean of six runs found to be 14·02 knots. The displacement was 480 tons, and the indicated horse-power 960. The engines worked throughout very smoothly, and notwithstanding the great speed there was an entire absence of vibration.

Messrs. Alex. Stephen and Sons launched on the 28th ult., from their shipbuilding and engineering works at Linthouse, a steel screw steamer, built for the Continental trade of Messrs. George Gibson and Co., Leith. The dimensions are:—Length between perpendiculars, 260ft.; breadth extreme, 32½ft.; depth moulded, 17½ft. Her engines (which have been fitted on board before launching) are of the triple-expansion type, having cylinders 23in., 37in., and 59in. diameter by 42in. stroke, supplied with steam from two large single-ended boilers constructed for a working pressure of 170lb.

The Technical Education of the Electrical Engineer.†

PERHAPS it would be well to call my subject the "College Education of the Electrical Engineer," for it is strictly of the technical college course that I shall speak. We can truly affirm that the technical education of an engineer does not end until his work is ended, and the college course is but the commencement of it. That the college course can be made a very important fundamental part of this education is becoming more thoroughly appreciated as the work of the technical schools comes into closer harmony with the demands of the profession, and it is now generally agreed that a technical college course, of the proper kind, forms a valuable aid towards the success of the average young man who wishes to enter the engineering professions. It therefore becomes a matter of no little moment to so arrange the course that its usefulness will be a maximum. A few years back a college course entirely devoted to the training of electrical engineers was unknown. At the present time there is no dearth of such courses, and their organisation is progressing right and left, whence it is well to carefully consider what requirements of the electrical engineer's profession they may be made to meet, in order that no powder be wasted. It is neither possible nor desirable that the courses of study of electrical engineering students in the various schools should be alike, but a certain unity of purpose and treatment should be observed, and all can profit by the suggestions made by the practical man.

With this in view, I present the subject to your attention as it is looked upon at the Engineering School of the University of Wisconsin. There is no originality claimed for the ideas presented, as they are based upon the recorded experience of some of the country's most successful practical men, and are virtually followed in such other engineering schools as make their courses thoroughly practical, and therefore, in the true sense, professional. I trust, however, that a discussion will arise that is in proportion to the wide importance of the subject to the electrical profession, and that must result in a considerable increase in the efficiency of the electrical engineering courses in our various colleges, nearly all of which are still in process of crystallisation.

In order to enter the freshman class of the best engineering schools, the applicant must have a thorough common school education, including mathematics through ordinary algebra, a fair knowledge of English, a reading acquaintance with German or French, a little elementary physics and chemistry. This can be gained in the high schools of most of the cities of this country. The high-school timber (some of it quite green) the college is required to work, and to work it to the best advantage requires no little careful designing. In order that an engineer may use his abilities and training most advantageously, he should have a good general education, including a fair knowledge of literature, history, economics, and certain elements of law. This cannot be expected to come from the high school, and you can readily appreciate that an attempt to give a general education in an engineering course can only result in sacrificing the good of the students by omitting essential fundamentals. Thus, to have an average chance of proving successful, an electrical engineer must be well grounded in three sciences besides those gained in the common school, and which cannot be classed as engineering. These are: Higher mathematics, as far as it may be practically applied in engineering; chemistry and physics, including elementary electricity and magnetism; and manual training. A few students enter college who have been given a fair start in these, but they are the exception; consequently, the subjects must be taught from the ground up, with a common-sense view to their practical applications. Unlimited time could be given to these preparatory subjects, but it is necessary to clear them away in the actual time of two college years. With this requirement it is impossible to give a very thorough knowledge of analytical chemistry, or of physics, but they are taught so as to give the student a good working knowledge, and so that he can readily go deeper if he finds it to advantage in his future practical experience. The higher mathematics require all the time that can be afforded, especially in its last division, that of applied mechanics, where the student gets his systematic knowledge of the properties and uses of materials.

With the preparatory studies cleared away the student must enter into professional studies in earnest, but there is little time for true engineering. The developing electrical engineer must expand his physics and his chemistry and mathematics into the laws of electro-magnetism, alternating currents, electrolysis and electro-metallurgy, and study the conditions of their numerous practical applications in engineering and the arts, each of which may demand months of constant effort before an intelligent mastery is attained. Neither can he confine his attention to these during two full years, for he must gain an elementary but practical knowledge of thermodynamics and hydraulics, with an efficient working knowledge of their applications in steam and water-power plants. He must also get a common-sense knowledge of the principles underlying the design, manufacture and selection of machinery.

This is a great deal to expect a student to efficiently absorb in four years, and it requires a most judicious selection in order that nothing unessential be allowed to enter, and that nothing essential be omitted.

Upon completing his technical college course at the University of Wisconsin of four years, an average student has spent at least 144 weeks of hard study, much of it of a practical workaday nature. During this time he has been called upon to spend upwards of five hours per day in class-rooms and laboratories, and about as much more time in individual study. No one is likely to go satisfactorily through such a course unless he has a decided taste for engineering work; but many students find themselves capable of doing a considerable amount of extra work, and yet have sufficient time for recreation to keep their health and spirits. It is well for an engineering course to stand beyond the reach of students without a taste for the work, for a successful engineer must be pre-eminently an enthusiast, while he is at the same time a candid and careful thinker. Those who are not fitted by nature to become engineers are better placed in a general educational course at college, and they are then more likely to become useful to society and to themselves than if passed through the technical mill.

It may be here asked, Of what use is the severely specialised education to the successful student in the engineering courses? The graduate does not become an engineer merely because he has successfully met the college examination. College cannot make an engineer, however practical the course of study may be. Practice has made thousands of good ones without the aid of the college, but I venture to say that these would frequently have become more eminent if they had received a thorough technical college course. While theory alone, wherever learned, cannot make a practical man, it is the one who can follow the guide of theory along the paths of practical work and experience who makes the fully-developed engineer. In order, however, that neither theory nor practice may lead him astray, he must have a well-educated common sense. The eminent and eloquent engineer, Alexander L. Holley, well illustrated this in one of his addresses when he said: "Mere familiarity with steam engines is not indeed a cause of improved steam engineering, but it is a condition. The mechanical laws of heat were not developed in an engine house, yet without the mechanism which the knowledge derived through this familiarity has created and adapted, the study of heat would have been an ornamental rather than a useful pursuit. So in other departments. . . . When one in any art can make a diagnosis by looking the patient in the face rather than by reading about similar cases in books, then only may he hope to practically apply such improvements as theory may suggest, or to lead in those original investigations upon which successful theories shall be founded."

Another illustration of the advantage of the technical-college course lies with the designer. To design good machinery is a natural gift, and to become thoroughly successful requires long experience, in order that the widely varying requirements may each be given due weight. Proper instruction at the technical school may here do much toward stimulating an appreciation of the lessons of experience. The considerations of primary importance to be followed in designing machines are admirably divided by Prof. A. W. Smith into four: 1st, adaptability; 2nd, strength and stiffness; 3rd, economy; 4th, appearance. In developing the design of a machine, the practical but highly sanguine inventor often forgets all the considerations except the first. A theoretical draughtsman may figure the strength to great precision by formulas that may not fully cover the required conditions, and in the meantime forget the

† Abstract of a paper read before the American Institute of Electrical Engineers by Dugald C. Jackson.

…scher considerations. When the design reaches the shopman, it must be altered to suit his views of economy, as the prime factor. A machine is thus produced that has lost part of its adaptability as designed, and has neither sufficient stiffness to properly do its work, nor a thoroughly substantial workmanlike appearance. The economical shopman has been defeated in the object, for the machine is hard to sell or requires costly repairs at the expense of the … proper college course should … a man, so that he can … appreciate the demands of the … operations of practice, and will … formulas with common sense and … If we replace our three men … machine transaction by men of equal experience and a technical-college education of the right sort, the work of each should supplement the work of the other, and the product can be predicted, with some confidence at least, to be a satisfactory commercial one The fault of much of the college training for engineers has been the lack of this education of the common sense or judgment. The result has often been graduates with as great a contempt for the practical man as the latter could return. These graduates have, it is needless to say, been a failure in their calling, and it is such men that technical colleges should not turn out. The best engineering schools desire to, and do turn out men who have a capacity for practical work and research, and who are in a fair way to make useful engineers.

We can now usefully inquire into the specialised work that should be prescribed for the average electrical engineering student during his last two years at college. Up to this point students in mechanical and electrical engineering courses have received virtually the same instruction. Here, we hold with several others, their paths should diverge. The student of mechanical engineering goes into careful study of shop practice, designing and utilising various types of machinery, and smaller subjects. The electrical engineering student must receive a good working knowledge of the problems of the mechanical engineer, but he must above all be trained in the practical problems of electrical engineering. He, therefore, goes into a study of that which will aid most in making him truly an electrical engineer. His knowledge must all be based on mechanical laws, but he must be much more than one-tenth electrical.

Before reaching his truly professional studies, the student should gain, during his course in physics, a common-sense grasp of the elementary notions of electricity and magnetism, and of the "all-pervading law of Ohm." The latter can be properly enforced in the laboratory by placing in the student's hands ordinary electrical instruments, such as bridges, galvanometers, ampèremeters, voltmeters, etc. Before beginning his specialised work, the student's knowledge of Ohm's law and its common results should have become almost instinctive.

With due regard for his preparation, it seems best to arrange the professional studies for the average electrical engineering students in four divisions, thus :—

1. Electro-magnetism and its application to practical uses, with special reference to dynamos and motors.

2. Electro-chemistry (including primary and secondary batteries) and electro-metallurgy.

3. Alternating currents and alternating current machinery, including dynamos, converters, condensers, etc.

4. The special application of the preceding divisions in electric-light, power, railway, mining, and other types of plants.

The last division is allotted about twice the amount of time given to each of the others.

While higher mathematics is a useful … in each of the divisions, its limitations … must be carefully set forth in … and laboratory. For the … educating the judgment and … the limitations of theories and … deductions, the laboratory … As much as one-half of … by the student under … instruction of the professors of … should be devoted to … This work, moreover, … deal with com… machinery, and … the methods of testing and … in practice. Physics, … steam engine, … electrolysis, alter… and their subjects, should … properly represented by a commercial … equipment, which is made use… in every-day instruction under the … of a man who has had experience … commercial work. The laboratory method of educating the student is unfortunately too little developed in many of our engineering schools, but a strong movement has begun in most schools to increase it in efficiency and amount. At the University of Wisconsin we carry the laboratory instruction as a part of the required work in every subject in which it is possible.

While the specialised course of the electrical engineering student during the last two years is largely devoted to strictly electrical engineering, he is also given proper classroom and laboratory instruction in useful allied subjects, such as the steam engine, boilers, water wheels, laws of contracts, etc., as has been already explained.

Students who are mature and show that they can usefully specialise more severely than is done in the regular prescribed course are permitted, by election, to devote a greater proportion of their time to either of the first three divisions already enumerated. Thus a student may have reason to know that a thorough course in electro-metallurgy will be specially useful to him. In this case his work in the second division is increased beyond the course requirements, and his work in the first and third divisions is proportionately decreased. Other things being equal, a student who has thus arranged his course may graduate with his classmates who have followed the fixed course as laid down. In the same way a student of sufficient maturity, who feels assured of special advantages in the field of electric transmission of power or electric railways, may increase his work in the first or third divisions and proportionately decrease it in the second.

In order that the student may have a fair opportunity of growing "wiser and better" in the practice of his art, he should be given reasonable encouragement. As Mr. Holley once said, an understanding should obtain "among the owners, directors, and commercial managers of engineering enterprises that it is not a matter of favour, but a matter of as much interest to themselves as to any class, that young men of suitable ability, and of suitable preliminary culture, however acquired, should have an opportunity and encouragement to master the practical features of technical education in works, not as mere apprentices, but under reasonable facilities for economy of time and completeness of research."

The Size of Chimneys.*

THERE is no standard rule that will apply to the calculation of the proper dimensions of chimneys for all conditions of operation of boiler furnaces. Soft coal is the most common fuel, and a chimney designed for such fuel would not be altogether suitable if hard coal, wood, sawdust, or shavings were used.

The rule of thumb commonly employed, and which gives good results in nearly every case, is to make the area of the chimney 25 per cent. greater than the combined area of the tubes in the boiler, making the height of chimney sufficient to bring the top far enough above the surroundings so that the eddying wind will not pour into the top. In the case of natural draught this works very well with soft coal, but it is not to be expected that the same size of chimney would be most suitable for other kinds of fuel, or where forced draught was used. It is a common impression that the higher the chimney the stronger the draught; but this is not altogether correct, as much depends on the area, and in fact the area appears to be the most important feature where a strong draught is required, for in chimneys of small diameter the friction of gases along the sides, even when a smooth material such as iron is used, is so great as to practically reduce the active area to some extent, and this becomes a larger percentage as the diameter of the chimney is smaller.

Experimental investigation on this subject has shown that in the case of brick chimneys, plastered on the inside to make them as smooth as possible, the friction is equal to reducing the diameter by an amount equal to 2in. on each side, or 4in. of the diameter if a frictionless chimney could be provided. With iron stacks the friction is less, or about three-fourths this amount, while they are clean; but as soon as they become coated with soot the friction is about the same.

In calculating the draught, the buoyancy of the gases is considered as being the only factor which produces the draught, except in cases where the wind blows into the firebox. Writers have cited cases, and nearly every engineer has observed that there is always a strong draught in a chimney of ample area when there is no fire in the furnace, and the difference in temperature of the air at the top and bottom of the chimney is very slight, in fact not sufficient to account for the strength of draught found on the theory of the increased buoyancy of heated gases.

The practical part of this subject is: What dimensions of chimney are required to burn a given number of pounds of coal per hour producing the best combustion attainable in an ordinary furnace? All rules pertaining to this subject include as a factor the square root of the height as determining the strength of draught. A little calculation on this point will show that but little is to be gained by increasing the height of a chimney beyond a certain point, if we consider the cost required to do so, as in no case would doubling the height increase the draught 50 per cent.; but if we should apply the same calculation to increasing the area, we should find that the gain increases more rapidly than the increase of area, on account of the reduction of friction proportionately as the area is increased. In dealing with the diameter of a chimney the area increases as the square of the diameter, and in this way the greatest gain may be expected, for a slight increase in the diameter will produce much better results than a proportionate increase in the height, providing the top of the chimney is above the tops of buildings or other objects which might obstruct the free course of the wind.

The temperature of the gases in the stack makes so little difference in the strength of draught that no great gain need be sought for in practice on this point, for an increase in the temperature from that of steam at 75lb. to that of melted lead—one of these being the lowest temperature which might be expected, and the other the greatest practicable, or at least within the limits of economy—would give an addition of less than 5 per cent. in the amount of air passing through the grates, so that the height and area are the only elements necessary to consider for strength of draught in an ordinary chimney. As an increase in height within practicable limits adds but little to the intensity of draught, it is always better to have sufficient area, for a large volume of air and gases passing upward at a given speed will require the in-rush of sufficient air to comply with the demands of the chimney, or at least it will tend to this, and the supply of air will then be restricted only by the thickness of fire, which will interpose resistance to the passage of the air, as can be noticed by the draught gauge, which will show a greater pressure as the supply of air through the fire is reduced, because the buoyancy of the gases in the chimney then becomes greater, and an insufficient quantity of air rushing into the chimney to supply the requirements of the draught leaves a partial vacuum, while the pressure of air on the draught gauge (water glass) becomes greater.

When making calculations as to the amount of air passing through the fire, and taking the reading of the draught gauge as an indication of the velocity, it must be remembered that the amount of air passing through the fire will be to a certain extent inverse to the pressure shown by the gauge. The draught gauge shows the difference in pressure between the gases on the interior and the air outside of the chimney, and the more admitted at the bottom of the chimney the less will be the difference in pressure and the less the difference in level of the water in the two limbs of the glass. This can easily be determined when carrying a heavy fire by noting the reading of the gauge, then opening the firedoors, when it will be noticed that the pressure shown by the gauge falls considerably; or it may be further proved by opening the smokebox doors, which will give a more free ingress of air, reducing the difference in pressure; then by again closing the doors, and closing also the ashpit doors, so that the supply of air is practically shut off, the gauge shows a greater difference of level, indicating a higher pressure.

Nearly all of the rules and tables concerning chimneys for steam-boiler furnaces that are given in the engineer's handbooks deal with the horse-power, which, it is well known, varies considerably, not only with the style of engine used, but with the way the fuel is handled and the general construction of the plant, all of which are of so much interest when brought down to a valuation in dollars and cents. A simple rule for ascertaining approximately the amount of good coal which may be burned to good advantage in a furnace with a chimney of given size is: Multiply the area of the chimney in square feet by 16, and by the square root of the height in feet; the quotient will equal the number of pounds of coal which may be burned per hour, producing good combustion, when the conditions are as usual; temperature of gases in the chimney 600°, and the temperature of the outside air at 60°. In this calculation the area of the chimney is that at the top, or the smallest area above the level of the grates, and the height must be sufficient to bring the top of the chimney above surrounding objects.

*By Arthur Goodwin, in the "Stationary Engineer."

Trade Notes.

A new sugar refinery is being erected at Greenock.

Messrs. Jessop and Son, of Leicester, are making a 25-ton steam crane for Western Australia.

Messrs. J. G. Statter and Co., of London have secured an order for two electrical cranes for the Southampton Harbour Board.

The directors of Bell's Asbestos Company Limited have declared an interim dividend of 2s. 6d. per share for the six months ending the 30th of June.

Messrs. Barclay, Curle and Co., Whiteinch, have contracted with Messrs. Shankland and Co., Greenock, to build two sailing ships of about 2000 tons register.

Mr. T. R. Ellin, of "Footprint" Works, Sheffield, informs us that he has moved to more central and commodious premises situated at 4, Eyre-lane (near Surrey-street), where he will have increased facilities for the manufacture of his specialities.

The Coats Iron and Steel Works Coatbridge, are to be offered for sale again on July 13, at the reserve price of £25,000. The engineering works of Messrs. Goodwins, Jardine and Co., at Motherwell, are to be offered at the same time at a reserve of £40,000.

Messrs. George Elliot and Co., Cardiff, despatched, on June 30, the largest consignment of wire ropes ever shipped from South Wales. There were twenty ropes in all, made on the firm's well-known lock coil principle, weighing about 80 tons. Another consignment of 45 tons is now being prepared for shipment.

A demand for a concession to construct an electrical railway between Antwerp and Brussels has just been made to the Belgian Government by Mr. P. Van den Kerkhoven, of Ghent. The average time occupied in making the journey by rail at present is one hour, but by the electric railway it is proposed to reduce this to 25 minutes.

Messrs. Goddard, Massey, and Warner, Nottingham, who have just completed the erection of two sets of wrought-iron pit gear, 84ft. high, for the Ebbw Vale Iron, Steel and Coal Company, have secured an order for two other sets from Messrs. J. and R. Stott Milne, for their Bradbury Collieries, Stockport, while another set is in course of construction for an Indian colliery.

The Eastern Telegraph Company Ltd. announce that the accounts show, after placing about £68,000 to the reserve fund, a balance available sufficient to pay the fixed dividend of 3s. per share, being at the rate of six per cent. per annum on the preference shares, less income tax, and a final 2s. 6d. per share, with a bonus of 3s. per share, both tax free, on the ordinary shares, making, with previous payments on account, a total distribution of 6½ per cent. on those shares for the year ended March 31.

The placing of the order for two first-class mail steamers for the Royal Mail Steam Packet Company has only now been definitely arranged with Messrs. James and George Thomson Limited, and the leading particulars are as follow:—The tonnage of the vessels will be about 6000 tons, and they will be specially designed and fitted for a first-class passenger trade between Southampton and Brazil, River Plate, etc. The speed contracted for is 17 knots, and the latest improvements both in hull and engines will be adopted.

The New Conveyor Company Limited, 1, Metal Exchange Buildings, London, E.C., have just booked orders for their heavy stoking and steel spiral conveyors from Mr. Robinson, Derby; Messrs. Arthur Guinness, Sons and Co. Limited, Dublin; the London Tramways Company Limited, London; also an order for six large conveyors for a granary and oil mill in Hull. A large order for Little's patent steel rope conveyors, coal tanks, and ironwork for a new retort-house for the Corporation Gasworks, Leigh, Lancashire, has also been booked by the New Conveyor Company Limited. The Gas Committee of the Burnley Corporation have also placed the order for a large installation of these conveyors to distribute the coal automatically from the stores into long ranges of retorts. This makes three orders for complete conveyor and elevator plants for gasworks received by the New Conveyor Company Limited on Little's patent noiseless steel rope system within a week.

Wheel cutter in metal only. Every description of gearing. R. CHADLAW, 43, City-road, Manchester.

Having regard to the enormous circulation of THE MECHANICAL WORLD, the Editor suggests that it is by far the best medium for the insertion of every kind of "Wanted" advertisement, and the price is only one halfpenny per word. The Editor will be glad if MECHANICAL WORLD readers will kindly bear this in mind as occasion arises.

THE AGRICULTURAL SHOW AT WARWICK.—II.

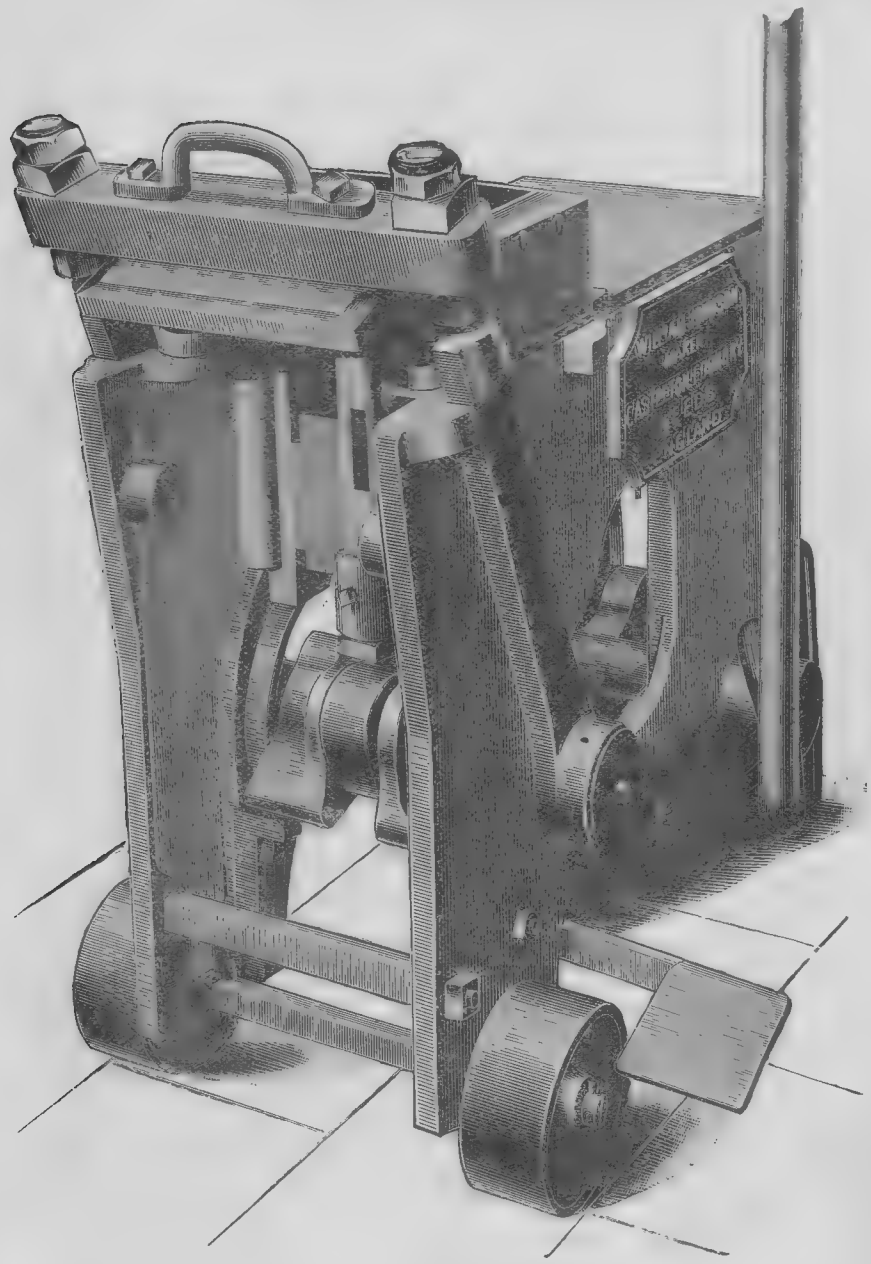


FIG. 1.

QUITE a number of brick-making machines were to be found at the Warwick show, those exhibited by Mr. William Johnson, Armley, Leeds, being very noticeable. In Fig. 1 is shown the "Eureka" hand-power brick and tile press, made by this firm, and which has been designed to facilitate the necessarily slow process of hand pressing. The action of the machine is very simple, and, owing to the peculiar arrangement, an enormous pressure can be exerted on each brick. The machine is portable, and, as the working parts are very compactly arranged, the attendant can run the machine alongside the stacks and feed press, and deliver the bricks or tiles without moving from the side of the machine.

Messrs. Ransomes, Sims and Jefferies, of Ipswich, who have always held a foremost place in traction-engine manufacture, exhibited one of their newly-designed road engines, of which we give an illustration in Fig. 2. The engine is constructed from entirely new patterns, and particular care has been bestowed upon the design to secure a neat appearance, and to reduce the number of separate details to the utmost extent consistent with efficiency. In the construction of this engine are embodied all the latest improvements, combined with substantial proportions, so as to render the engine equally serviceable for haulage purposes on the road when not required for thrashing. The boiler is of ample capacity, and strongly stayed for working safely and continuously at 141b. per sq. in. The hydraulic-test pressure is 2401b. The shell plates are of steel, and the fireboxes of Lowmoor iron. All the flanging and riveting are done by hydraulic machinery. The top of the firebox is not strengthened by the ordinary and very faulty roofing bars, but is stayed directly to the arch plate in an efficient manner. By this system of staying the firebox top may be kept free from scale and sediment.

It will be seen from the illustration that the cylinder is bolted down to the barrel of the boiler, as near to the chimney as possible. It is surrounded with a spacious steam jacket. Near the highest part of this steam dome the stop valve and throttle valves are placed. The top cover of the cylinder forms a base for a double spring-weighted safety valve, with easing lever; this lid also carries two displacement lubricators, one of which supplies oil into the working barrel of the cylinder, and the other delivers oil direct on to the slide valve face. We may here remark that one of the most annoying and dangerous troubles associated with many traction engines is that they have an irritating propensity for priming. In the engine under notice special provision has been made, both in the boiler and the cylinder, for preventing priming; and in order to test the efficiency of the arrangements, some engines of this type have been subjected to the roughest usage, running at high speeds with quick gear in, over rough ground, up steep hills, etc., and they have not shown a trace of priming, the exhaust working perfectly dry during the most severe tests. The governors are connected direct to an equilibrium throttle valve, and have complete control of the engine when used for thrashing or driving machinery from the fly-wheel. One bracket carries the governors, the valve-rod guide, weigh-bar shaft, throttle-valve spindle, and governor bevel wheels and pulley. The crankshaft is of ample size, the dip being bent out of a square bar of steel. Cast-iron eccentric straps are used in preference to brass; the link motion reversing gear is of a substantial character, having large pins; the extra large wearing surfaces are deeply case-hardened; the eccentric rods, links, and levers are all of flat section, as shown. The piston rod is of steel, and the four slide bars and blocks are of cast iron. Two countershafts are introduced, so that the fast and slow speed gearing are arranged between the bearings; the two pinions are cast together and keyed to the crankshaft inside the box brackets; the double-speed wheels slide on four keys cut out of the solid material of the countershaft. By this plan of inside gearing, the spur wheels subjected to heavy wear and tear are more fairly worn, all overhanging strains on the crankshaft are entirely obviated, and a narrower engine is obtained, a point of considerable importance in many districts in England. The bearings for the crankshaft, countershafts, and axle are of massive proportions. They are fitted into machined and bored holes in the side plates of the firebox shell, which are carried upward and backward for the purpose. Two transverse plates serve to stiffen the side horn plates, one of which is flanged, and the other provided with angle irons which are riveted in the corners. The tee-iron rings of the driving and leading wheels are of specially strong section. Compensating motion is fitted to the main axle, which allows the power to be transmitted through both the driving wheels when turning corners. The winding drum and steel wire rope are particularly

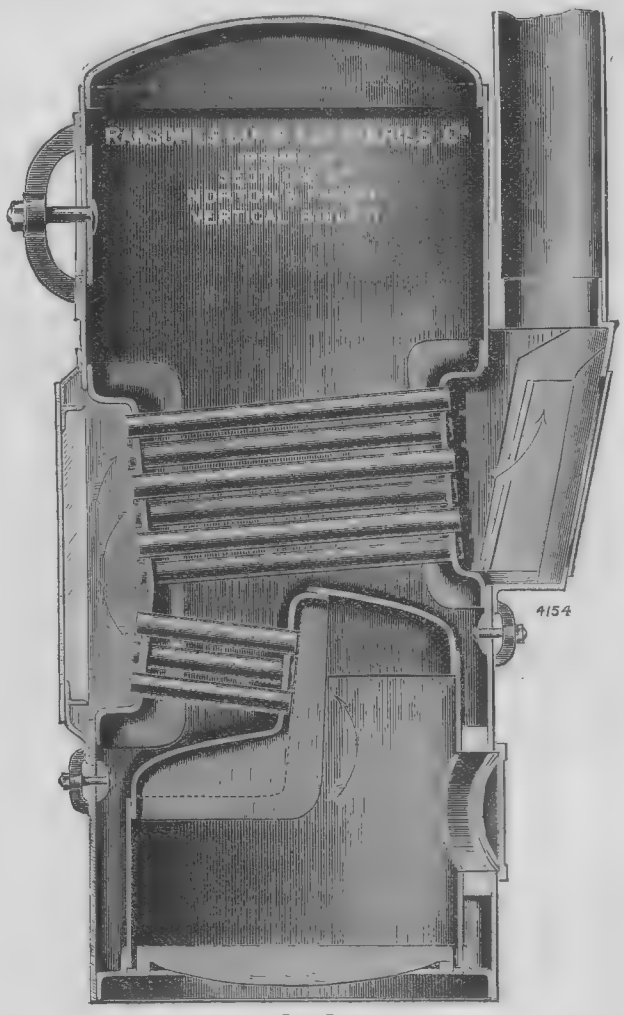


FIG. 3.

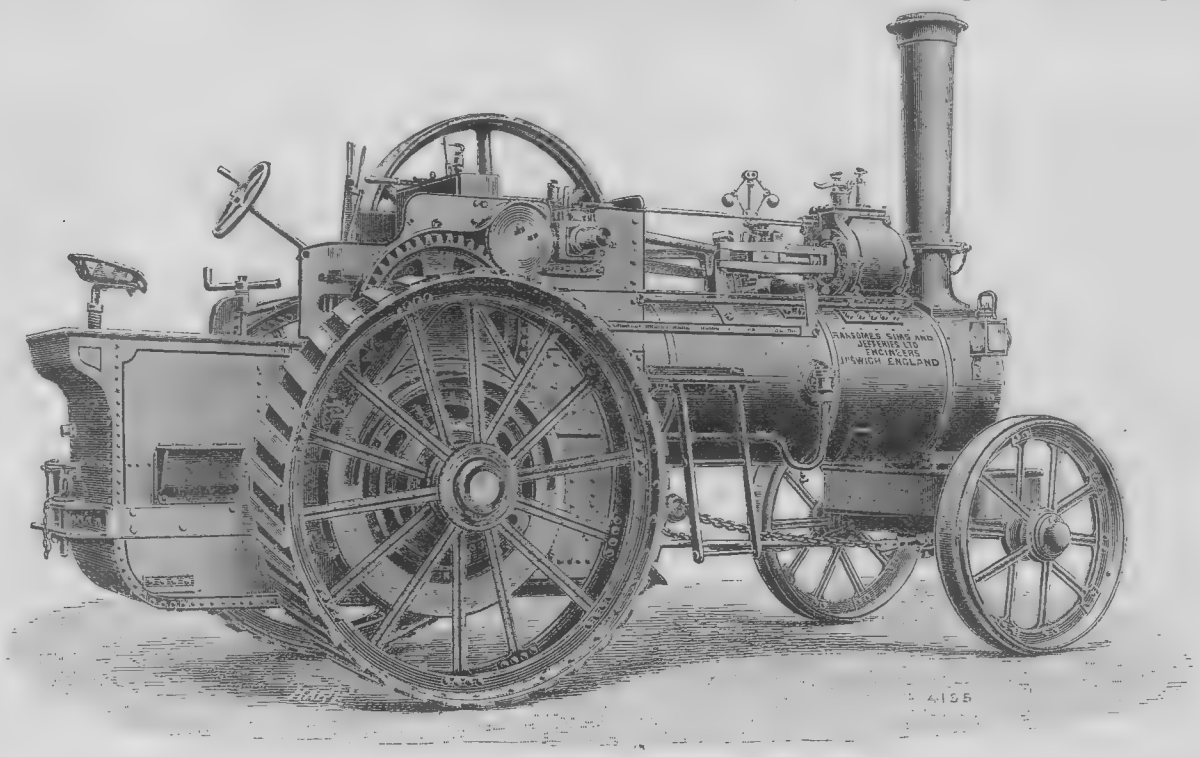


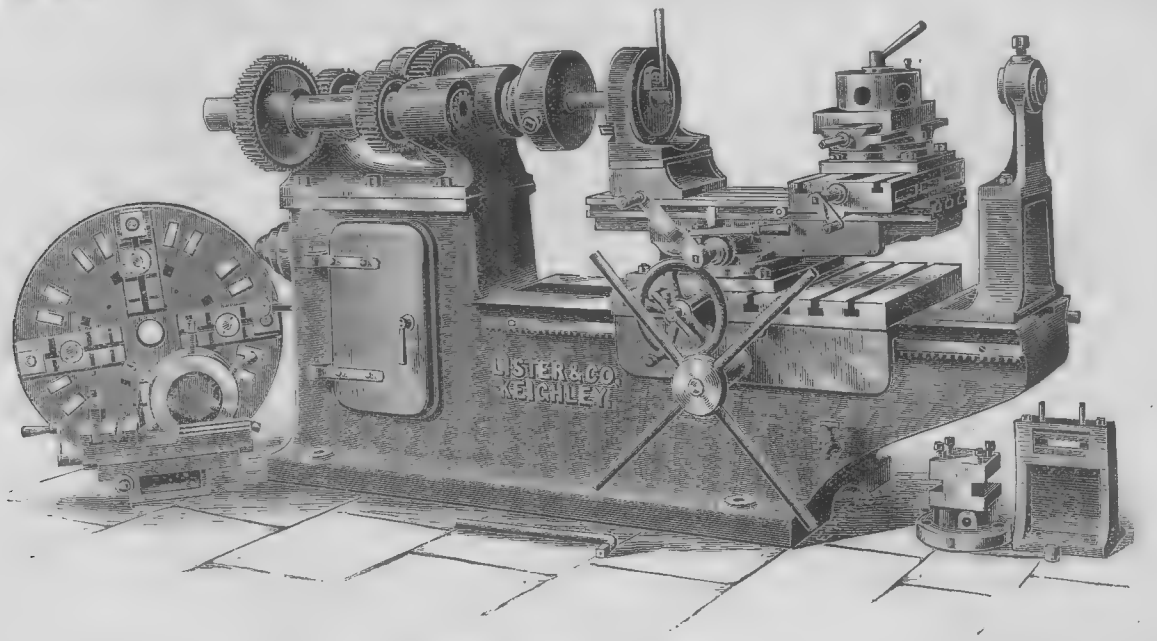
FIG. 2.

...sed for winding the thrashing machines ... stackyards, or over soft ground, ... for hauling wagons up steep hills, ... A screw brake is provided. The ... drawbar is flanged out of a thick steel ... plate, and extends across the back of the ... tender, as shown in the illustration. On ... each side are welded deep straps which ... take the pull from the horn plates, ... thus relieving the tender of all hauling ... strains. A series of holes are provided in ... the flange of the drawbar, so that the ... coupling pin may be moved out of the ... centre if required, when the engine is ... turning a sharp corner with a long train behind. In the case of traction engines with inside gearing made by some firms, the feed pump is usually crowded out of its ordinary place, and then fixed to the barrel of the boiler, away from the driver. In this instance, however, the pump is attached to one of the countershaft brackets close under the eye and control of the driver. The pump is of the continuous-action type, with brass valve boxes and valves. Some portion of the exhaust steam is conveyed to the return pipe from the pump for heating the feed water in the tank; cocks are introduced in the pipes by regulating the amount of heat, as well as the quantity of feed water forced into the boiler. All the joints in the feed pipes are made with flanges. A footplate and ladder are fixed as shown to facilitate the oiling and cleaning of the engine. A convenient box is attached to the front axle for carrying the speeds and heavy tools. Sliding firedoors are used, as they take up little room in the tender. Whenever possible rivets have been used in preference to bolts and nuts, for the gearing, etc. The engine ... with a water lifter and hose ... and all the usual accessories. ... are some of the dimensions ... engine exhibited :—

... 8in.; stroke, 10in.
... 9in.; width, 6in
... wheels, 5ft. 9in.; width,
... the axles, 6ft. 6in.

... and Jefferies ... their well-known ... 3H.P. vertical ... boiler, which is of ... type and shown in Fig. ... Nicholson's patent vertical ... The general arrangement will be ... understood from the illustration ... and it only remains to point out a ... the advantages claimed. In the first place, the use of horizontal fire tubes provides a maximum amount of heating surface in the smallest possible space, while the arrangement of the firebox and tubes ensures an efficient circulation of the water being maintained. It will also be noticed that all the heating surface is below the water line, and that the uptake, which is often a source of trouble in boilers of the cross-tube type, is dispensed with. Other points of advantage claimed are simplicity of construction, enabling all the plates to be flanged by hydraulic pressure, and every rivet to be put in by the riveting machine. The tubes are accessible for sweeping or examination, and mud doors are provided, enabling the scale to be readily removed from the sloping tops of the firebox and the water space, thereby adding to the durability of the boiler. This boiler should, we think, meet with considerable favour for all purposes where a small, simple, and economical steam generator is required.

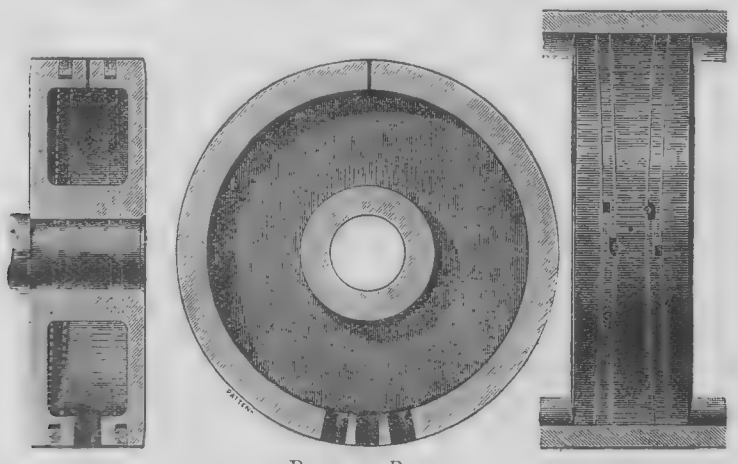
(To be continued.)



IMPROVED COMBINATION LATHE.

An American Balanced Piston.

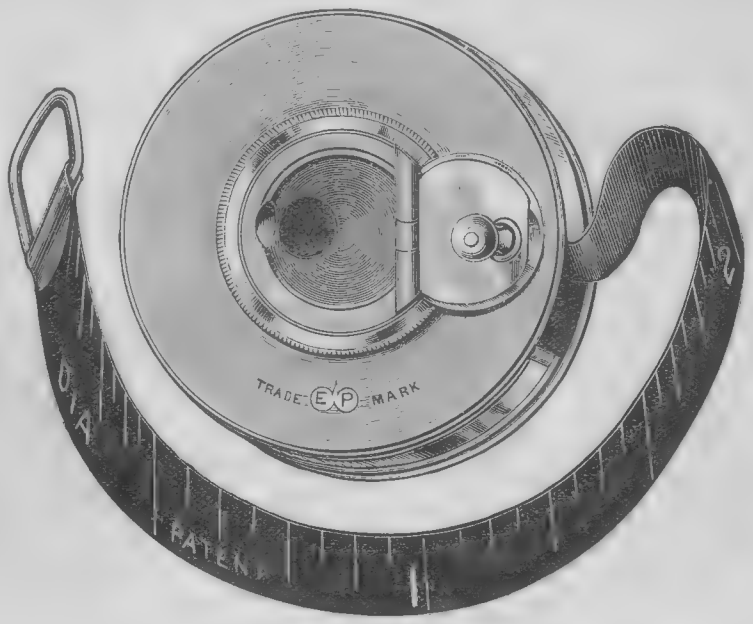
As may be inferred from the illustrations, this piston differs from the ordinary one only in the construction and relative position of the snap rings. These are set obliquely to the axis of the piston, being farther apart at the bottom, as shown in the section at the left. This gives a greater area between the rings at the bottom of the cylinder than at the top. The rings have lap joints, so constructed as to admit steam into the space between the rings and into the interior of the piston. The joints are continuous for the ring against the cylinder, and also against the side of the groove nearest the end of the piston, thus serving as check valves for the confinement of steam in the interior of the piston. When steam is admitted to one end of the cylinder, the ring at that end is forced to the opposite side of the groove, allowing the steam to pass down the side of the ring, under it, up through the space on the other side, around the dowel pin on top (shown in top view of piston in right-hand cut), into the space between the rings, and through the small passage into the interior of the piston and through the apertures at the bottom. This passage is open as long as the piston is not in contact with the top of the cylinder. As the pressure in the interior is raised, the upward movement of the piston caused by the larger area between the rings at the bottom, closes the inlet by contact with the top of the cylinder, thus preventing upward wear. In this manner the piston is supported by steam pressure, which automatically adjusts itself so as to prevent friction and consequent wear at the top or bottom of the cylinder. The application of those rings shown in the cuts (taken from "Power") is to a solid piston, but it is equally applicable to the old-style piston by changing the old bull ring for a new one. These balanced pistons are controlled by the American Balance Slide Valve Company, of 216, Mission-street, San Francisco.



BALANCED PISTON.

Broadbent's Patent Measuring Tape.

We have pleasure in directing attention to what we believe to be a novel measuring tape, and which is shown in the illustration herewith. The salient feature is that the graduations are so arranged that it is possible to ascertain at a glance the circumference corresponding to any given diameter, or the diameter corresponding to any given circumference. One side of the tape is marked in feet and inches in the usual way, while the other side is graduated in divisions of 3·1416in.—the ratio of the circumference of a circle 1in. in diameter to its diameter,—and these main divisions are further subdivided as shown in the illustration herewith. With this arrangement it will be seen that the diameter of any cylindrical object can be readily ascertained by simply passing the tape around it and reading off the result on the side marked DIA. There can be no question that engineers, mechanics, and others will find this tape of great service to them, and many applications will suggest themselves to those who have experienced the difficulty of ascertaining the diameter of pulleys when mounted upon shafts, or similar objects, which do not allow of a direct diametrical measurement being taken. Boilermakers, coppersmiths, and workers in sheet iron, zinc etc., will also find the tape of service, since by its aid it is easy to ascertain the exact diameter that can be obtained from any sheet when bent into a cylindrical form, even though it may be crooked and out of shape at the time. Smiths who require to weld up rings of given diameter can at once cut off their bars to the correct length—of course, making allowance for welding in the usual way; while the diameter of shafts and round bars can be readily determined without the aid of calipers. Particulars of these useful measuring tapes may be had from Messrs. Thomas Broadbent and Sons, Central Ironworks, Huddersfield.



PATENT MEASURING TAPE.

Improved Combination Lathe.

In many engineering establishments, especially those engaged upon work of a varied character, the installation of special tools is rarely warranted, as these are frequently unemployed for long periods at a time, and any temporary advantage which might have been gained is thereby more than offset by the enforced idleness of the tool.

The combination lathe which we illustrate herewith is intended to take the place of a number of special tools, the change from one arrangement to another being quickly and readily made. It is claimed that the tool will do the work of and form an effectual substitute for (1) a general-purpose lathe for boring and chuck work, (2) a taper-boring and turning lathe, (3) surfacing lathe, taking in diameters up to 40in., (4) hollow spindle capstan lathe for stud and bolt work, cutting off, etc., and (5) a screwing machine.

The lathe is furnished with twelve varieties of speed, and the gearing is machine cut. The spindle is of steel, and has a hole 2¼in. in diameter. The bottom carriage has a movement on the bed of 3ft. 6in., while the upper table or slide has a travel at all angles of 2ft. 6in. Self-acting feed arrangements are provided, also automatic stop motion. Both quick and slow hand motions are fitted. The equipment of the machine includes a number of chucks, stays, etc., which will render it capable of dealing with a large variety of work. Messrs. Lister and Co., Keighley, are the makers of this useful tool, and will be pleased to furnish additional particulars upon application.

Recent Boiler Explosions.

(*Continued from page 298, vol. xi.*)

No. 537 refers to a formal investigation into the bursting of a lard-refining double-cased pan, having a steam space of about 1½in. all round, and a dished bottom, while the outer casing was 8ft. 11in. diameter and the inner casing 8ft. 8in. diameter. Such a vessel could not be safe unless closely stayed, which does not appear to have been the case. The boilermaker who made the pan represented it as quite safe at 65lb. pressure; but the more experienced engineers representing the Board of Trade state that when new it could not have been safe at 20lb. The boilermaker stated that he calculated the strength of it when made, and consulted a book to guide him in the matter, but he failed to produce the book or work out a formula showing any such result. The Commissioners considered him to blame for having made and

sold a vessel as suitable for a pressure at which it was dangerous, and actually burst, and fined him £15. It is really surprising how so many makers escape trouble, as this class of article is generally made by third-class makers, most of whom are utterly incapable of estimating or calculating the strength of such structures, and only work by "rule of thumb."

No. 538 report refers to a very serious explosion. The boiler was one of a number, all of which appear to have been worn out. The maker and age of the boiler were, as usual, not known. The owners do not appear to have taken much care, either, of the boilers. They tried to insure them; but one company reported so strongly on the condition of the boilers and on the slipshod way in which they were kept, that the owners shortly afterwards proposed them in another company. This company also had occasion to report rather strongly, and protested against the irregular and unsatisfactory manner adopted in loading the safety valves. The guaranteed pressure appears to have been 25lb.; but on more than one occasion 30lb. was found, this latter pressure being asked for by the manager, but refused, as each of the insurance companies considered 25lb. quite sufficient. But 30lb. was often used, until ultimately the boiler burst, and the Commissioners very properly considered the owners to blame, and fined them £70 for their indifference or negligence.

No. 539 refers to a slight local defect which occurred in a marine boiler, near a flange. The plate corroded through in a hole 1in. by §in., and all the steam and water was blown into the bilges.

No. 540 refers to an investigation which reveals a most unsatisfactory state of affairs on board tug-boats. It appears that after the boilers under investigation had been working for a number of years they required some repairs, and a respectable firm were asked to send men, which they did; but when their foreman called in and saw the state of the boilers, he at once ordered the men to cease work, as it was evident the boilers were beyond efficient repair. The works manager also examined the boilers and told the owner the same thing, but this the latter denied. The boat with engines and boilers was then sold, and the new owner called in a local boilersmith, who did some patching, and the boilers were set to work. Soon after some more patching was done by the same boilersmith, and eventually the boiler exploded from sheer weakness, the plates being reduced in many places to brown-paper thickness—really worn out. It was fortunate no lives were lost, or, as the Commissioners stated, they would have felt it their duty to hand the papers over to the Public Prosecutor. The boat was several times surveyed, but boilers and engines, although reported in good condition, were never once looked at. The owner was considered to blame and ordered to pay £50 to the Board of Trade.

No. 541 refers to the explosion of a tank originally intended for and worked in connection with an evaporator. It was at the time of the explosion used to collect the steam from main donkey engines, which was condensed and used again. There did not appear to be a free outlet, consequently pressure accumulated until the end was blown out, doing much damage, but fortunately killing no one.

(*To be continued.*)

Report upon Trial of the P.S. "Ville de Douvres."

(*Concluded from page* 310, *vol. xi.*)

Fuel Consumption.—The total fuel burnt was equivalent to 7380lb. per hour. This would amount to a gross consumption of 2·481b. of total fuel per indicated horse-power of the main engines per hour; but assuming that 6·57 per cent. of the total amount was consumed in making steam for the three auxiliary engines, as already explained, this would reduce the net consumption of fuel on behalf of the main engines alone to 6900lb. per hour, or 2·32lb. per indicated horse-power per hour, which is equivalent to 2·30lb. of carbon value per indicated horse-power per hour.

Engine Efficiencies.—The total indicated horse-power of the main engines was 2977; and the total gross feed-water used per hour by the main engines and the three auxiliary engines which were at work throughout the trial was 66,180lb. This would amount to 22·23lb. of gross feed-water per indicated horse-power of the main engines per hour; but, as was shown in an earlier paragraph, 6·57 per cent., or 4350lb., per hour of the total feed-water was probably used by the three auxiliary engines, so that the net feed-water used by the main engines alone would be 61,830lb. per hour, which is equivalent to 20·771b. of net feed-water per indicated horse-power per hour. The total actual heat received by the gross feed-water per minute was 1,169,000 thermal units, which is 66·1 per cent. of the whole heat of combustion. Similarly the actual heat received by the net feed-water used by the main engines would be 93·43 per cent. of this amount, or 1,092,000 thermal units per minute. The absolute engine efficiency of the main engines alone, or ratio of the heat turned into work by them to the heat given to the net feed-water, was 11·7 per cent.

Total Efficiency.—The combined efficiency of the boilers and engines, or ratio of the heat turned into work to the total heat of combustion of the fuel, allowing for the 6·57 per cent. of the feed-water which was consumed by the three auxiliary engines, was 0·661 × 0·117, which is equivalent to 7·7 per cent.

Steam from Indicator Diagrams.—The following are the results of measurements made upon the indicator diagrams taken, to ascertain the proportion of steam accounted for by them. The actual weight of net feed-water used by the main engines per revolution was 27·991b.

Proportion of Steam Accounted for by Indicator Diagrams.	Lb. per Revolution.	Percentage of Total Feed.	Percentage present in Cylinder as Water.
	Lb.	Per cent.	Per cent.
Steam present in high-pressure cylinder after cut-off, when the pressure was 81·2lb. per square inch above the atmosphere....	22·57	80·6	19·4
Steam present in low-pressure cylinder near end of expansion, when the pressure was 0·81b. per square inch below the atmosphere, ...	20·29	72·5	27·5

Speed of Vessel.—The following extract from the ship's log has been kindly furnished by M. Lecointe:—

The mean speed between the times of passing Nord-Hinder light-vessel on the outward journey and arriving in Ostend Harbour, which includes nearly the whole of the trial, was therefore 17·1 knots. The mean speed over the trial, excluding the passage from Outer-Gabbard light-vessel to Corton light-vessel, during which the 14 minutes of slowing down occurred, was 17·5 knots.

Time.	Observations.	Distance Measured from Chart.
Sept. 8, 1891.		Nautical Miles.
7-30 a.m.	Left Ostend Harbour ..	0
10-30 „	Passed Nord-Hinder Light-vessel	26
12-14 p.m	Passed Outer-Gabbard Light-vessel (speed reduced for 14mins.)..	57
2-20 „	Passed Corton Light-vessel.....	90
4-18 „	Repassed Outer-Gabbard Light-vessel	125
6-4 „	Repassed Nord-Hinder Light-vessel	156
7-37 „	Returned to Ostend Harbour	182

There is added to this report a table showing the leading results of the trial of the "Ville de Douvres," and beside these are placed the corresponding figures for the closed circuit transformer. The E.M.F. used in the experiments was obtained from a storage battery, and the method of experiment was to trace the curve, giving the relation of current to time on a chronograph sheet.

One set of experiments shows the effect of varying the impressed E.M.F. on the time required for the current to attain any given percentage of its maximum strength. The results show that for any particular percentage there is always a particular E.M.F. which takes maximum time. Thus for the circuit under consideration, and with successive repetitions of the current in the same direction, it takes longer time for the current produced by an impressed E.M.F. of 4 volts to reach 95 per cent. of its maximum, than it takes for the current produced by either 3 volts or 5 volts to reach 95 per cent of their maximum. The results show also that, within considerable limits, the time required for the current to become uniform is on the whole nearly inversely proportional to the impressed E.M.F., and that for moderate values of the E.M.F. the time may be very great. When the E.M.F. was 2 volts, and

COMPARATIVE RESULTS OF THE TRIALS OF FIVE SCREW STEAMERS AND ONE PADDLE STEAMER—S.S "METEOR, "FUSI YAMA," "COLCHESTER," "TARTAR," "IONA"; P.S. "VILLE DE DOUVRES."

	Name of Vessel	"Meteor."	"Fusi Yama."	"Colchester."	"Tartar."	"Iona" (Committee).	"Iona" (Chief Eng.)	"Ville de Douvres."	
	Mean Pressures.	Lb. per sq. in.							
49	Calorific value of 1lb. of fuel as used .....Th. U.	12,770	12,760	13,280	14,995	14,830	—	14,390	49
50	Percentage of line 49 taken up by feed-water.....per cent.	62·0	67·2	62·0	—	69·2	—	66·1	50
51	Do. carried away by furnace gases .....per cent.	21·9	23·5	28·0	22·1	16·2	—	26·8	51
52	Do. lost by imperfect combustion .....per cent.	3·6	0·0	1·3	0·0	0·0	—	0·0	52
53	Do. used in evaporating moisture in coal....per cent.	1·2	0·9	0·4	0·0	0·0	—	0·0	53
54	Do. unaccounted for..per cent.	11·3	8·4	8·3	—	14·6	—	7·1	54
55	Heat taken up by feed-water per minute .....Th. U.	528,600	141,100	788,700	[403,600]	161,100	—	1,169,000 / 1,092,000*	55
56	Heat turned into work per minute.....Th. U.	85,240	15,870	84,630	46,490	27,590	30,250	127,300	56
57	Heat taken up by feed-water per I.H.P. per minute.Th. U.	265·6	380·0	398·4	[371·2]	249·6	—	392·7 / 366·8*	57
58	Efficiency of boiler (line 50) per cent.	62·0	67·2	62·0	—	69·2	—	66·1	58
59	Do. of engine (line 56÷line 55) per cent.	16·1	11·2	10·7	[11·5]	17·1	—	11·7*	59
60	Do. of engine and boiler combined (line 58×line 59)..per c.	10·0	7·6	6·6	9·7	11·8	—	7·7*	60
61	Mean velocity of steam through water-surface in boilers per minute .....ft.	—	6·28	8·60	3·43	1·61	—	8·61	61
62	Space occupied by boilers per I.H.P. .....cubic ft.	2·72	4·53	2·52	4·33	4·15	4·15	2·09	62
63	Weight of engines, boilers, etc., with water, per I.H.P.....ton	0·20	0·27	0·20	0·27	0·31	0·31	0·12	63
64	Clearance volume, high-pressure cylinder .....per cent.	12·4	8 5	(two) 9·39	14·51	12·41	12·41	15·0	64
65	Do. intermediate cyl..per cent.	9·3	—	—	9·25	10·11	10·11	—	65
66	Do. low-pressure cyl..per cent.	8·02	5·0	(two) 6·23	5·10	7·64	7·64	12·0	66
67	Clearance surface, high-pressure cylinder .....sq. ft.	—	17·3	(two) 22 6	25·4	12·75	12·75	34·73	67
68	Do. intermediate cyl. ....sq. ft.	—	—	—	40·1	29·14	29·14	—	68
69	Do. low-pressure cyl. ....sq. ft.	—	42·5	(two) 56·9	79·6	49·5	49·5	211·46	69
70	Speed of vessel, mean, during trial.....knots	11·6	—	14·4	—	8 6	9·0	17·1	70
71	Mean temperature of outer air F.	—	55°	55°	55°	62°	91°	61°	71
72	Do. chimney gases .....F.	791°	578°	835°	477°	452°	—	910°	72
73	Do. feed water .....F.	163°	129·5°	113°	101°	106°	157°	158°	73
74	Do. boiler steam .....F.	363°	304°	324°	362°	373°	371°	342°	74
75	Do. circulating water.....F.	—	—	—	—	55·8°	78·6°	61·70°	75
76	Do. discharge water .....F.	—	—	—	—	75·5°	94·4°	85·0°	76

* Allowing for the three auxiliary engines.

The Measurement of the Magnetic Properties of Iron.*

THIS paper gives the method of experiment and results obtained in some investigations on the time-rate of rise of current in a circuit having large electro-magnetic inertia. The experiments were made on a circuit containing the coils of a large electro-magnet having laminated cores and pole-pieces. The mean length of the iron circuit was about 250cm., and its cross section 320 square centimetres. The magnetising coil had 3840 turns, when all joined in series, and a resistance of 10·4 ohms. The coils were so arranged that they could be joined in a variety of ways, so as to vary the resistance, inductive coefficient, etc., and also to allow the magnet to be used either as an open or a six trials which have been reported on previously—namely, those of the "Meteor," "Fusi Yama," "Colchester," "Tartar," "Iona," and the subsequent trial of the "Iona" carried out by the chief engineer of the vessel. There is also added an appendix giving a list of the members of this institution and others who took part in the trial of the "Ville de Douvres."

* A paper by Thomas Gray, B.Sc., read before the Royal Society.

Another set of experiments gives the effect of successive reversals of the impressed E.M.F. at sufficient intervals apart to allow the magnetisation to be established in each direction before reversal begins. In this set also the effect of cutting out the battery and leaving the magnetic circuit closed is illustrated, showing that several minutes may be required for the magnet to lose its magnetism by dissipation of energy in the magnetising coil. The effect on these cycles of leaving an air space in the iron circuit is also illustrated. It is shown that a comparatively small air space nearly eliminates the residual magnetism and diminishes considerably the rate of variation of the coefficient of induction and the dissipation of energy in the magnet.

the current sent in such a direction as to reverse the magnetism left in the magnet by a previous current of the same strength, the time required for the current to establish itself was over three minutes. The difference of time required for repetition and for reversal of previous magnetisation was also very marked when the iron circuit was closed. The results show that great errors may arise by the use of ballistic methods of experiment, especially when weak currents are used, and that for testing resistances of circuits containing electro-magnets a saving of time may be obtained by using a battery of considerable E.M.F.

Several cycles are shown for the magnet used as a transformer with different loads on the secondary. The results give evidence that there is less energy dissipated in the iron the greater the load on the secondary of the transformer.

Some experiments are also quoted which go to shew that the dissipation of energy due to magnetic retentiveness (magnetic hysteresis) is simply proportional to the total induction produced when the measurements are made by kinetic methods. Reference is made to the recent experiments of Alexander Siemens and others, which seem to confirm this view.

An Experiment with Aluminium in Iron Castings.

SOME experiments with aluminium in iron castings have been made by Mr. W. Wallace Christie for the Ramapo Ironworks. The results are given in a paper read before the San Francisco meeting of the American Society of Mechanical Engineers. The results of the experiments as given in this paper are about as follow:

Two mixtures for cast metal were made and the castings tested. The mixtures were:—

	Mix. No. 1.	Mix. No. 2.
Wrought-iron turnings	101b.	101b.
Cast-iron turnings	101b.	5lb.
Steel rail chips	101b.	15lb.
Ferro-silicate of iron and aluminium	2lb.	2lb.

The melting was done in a brass founder's furnace and required about three hours' time to melt. After being melted the ferro-silicate of iron and aluminium was added and thoroughly stirred into the mass. The castings were made in green-sand moulds without charcoal facing. When the skin of sand was removed the castings were found smooth and clean. The castings were 1¼in. diameter by 14in. long.

There was some difference found in the metals when under heat, mixture No. 1 being very fluid when hot and white, and had to be poured quickly, as it cooled rapidly. It made a homogeneous casting, had a very bright facture, and could not be cut by a specially hard tempered tool. Mixture No. 2 was not so fluid or so white when melted; casting was not so homogeneous and had a duller fracture. It was very hard and resisted cutting tools more than No. 1. Both specimens retain their original brightness of fracture after a year's exposure, crumble at a high red heat, and could be worked slightly under a steam hammer at a dull red heat. Mixture No 1 flattened to 1½in. and No. 2 to ⅜in. before crumbling. No. 1 was subjected to a tension test after being remelted and cast into suitable shape. It broke at 44,700lb. per sq. in., the facture occurring in the jaws of the machine, and in the large section owing to a cinder flaw in casting. The tensile strength would have been higher but for the flaw in the casting and the uneven grip in the jaws of the machine. In the impact machine, with 6in. between supports, a weight of 25lb. falling 1⅜in. was required to break a circular section of ½sq. in. The ferro-silicate of iron and aluminium used was an ordinary commercial article. The writer suggests using these mixtures for floor plates where wear and not strength is needed, and for bearings for pivots. The metal cannot be worked in machines owing to its extreme hardness.

Water Rams in Steam Pipes.

IF steam be introduced below the surface of water contained in a large vessel, a bubble will be formed which will increase in size until its surface becomes sufficiently extended to condense the steam more rapidly than it can enter, when a partial vacuum will be created. the bubble will collapse, and the water flowing in from all sides at a high velocity will meet with a blow forming what is called a water ram.

Such explosions occurring in the middle of the mass create simply a series of sharp noises. But if steam be blown into a large inclined pipe full of water, it will rise by difference of gravity to the top of the pipe in the form of a bubble; and when condensation takes place the water below the bubble will rush up to fill the vacuum, giving a blow directly against the side of the pipe. As the water recedes the bubble gets larger and moves farther and farther up the pipe, the blow each time increasing in intensity, because the steam has passed a larger mass of water, which is forced forward by the incoming steam to fill the vacuum.

The maximum effect generally occurs at a closed end. Even if the water does not originally extend to the end of the pipe, if this be filled with steam which has bubbled through water on its way to that point, there may be sufficient cold metal to condense it; and when collapse takes place, the whole mass of water in the pipe is driven against the end, sometimes with sufficient force to rupture it.

A dangerous water ram may be produced in a pipe filled with water, even if the end be open, should the pipe be crowned upward at any part of its length. A bubble will form at the top of the crown, and there collapsing, water will be forced in by atmospheric pressure from one end and by steam pressure from the other, and the meeting of the two columns may rupture the pipe. The same action can occur in a level pipe, but not in one which descends away from the entering steam, so that the latter is always above the water.

* Inst. C.E.: Foreign Abstracts.

Metal Trade Memoranda.

The output of ore from the Marbella Iron Ore Company's mines for the month of June was 8594 tons.

The Hanneton Rolling Mills, Brussels, have resumed operations. A Siemens gas furnace has been erected at these works.

The export of gold from Cape Colony during the month of June amounted in value to £390,000, being an increase of £169,000 as compared with the corresponding month last year.

During the month of May Germany imported from England 12,637cwt. of unwrought copper and 529cwt. of wrought copper, as against 12,128cwt. and 306cwt. respectively in May, 1891.

The Jarrow Forge Company Limited are extending their works and putting down new plant, so as to be able to manufacture stern frames throughout, by doing the machining as well as the forging.

A joint-stock company has lately been formed in Buenos Ayres, under the style La Aurifera Jujuena, to work certain goldfields in Jujuy, where there is said to be abundant mineral wealth The concession is for deposits at Ajedrez, in the department of Rinconada. The goldfields are said to cover a total area of 26,250 acres, 10,000 acres of which are in Bolivian territory. One great advantage, it is reported, is the existence of abundance of fresh water.

The nature of the sunken pits and mounds found in Ekaterinoslav and Bachmut, Russia, so long a mystery, has been made known through the enterprise of Messrs. Auerbach and Co. Upon investigation a bed of sandstone, impregnated with cinnabar, was found interstratified with beds of carboniferous formation. In 1887, 12,000 tons of ore were raised, giving employment to 125 men. This ore was treated by two cupolas and two reverberatory furnaces, 85 men being employed. Two thousand two hundred tons treated in the reverberatory furnaces yielded 20¾ tons of quicksilver; 9000 tons treated in the cupolas yielded 42·3 tons, being a little over ½ per cent. of metal.

The imports of tinplates into the United States appear to be steadily increasing again, in spite of the M'Kinley tariff. The following table shows the figures, according to the American official returns, for the first five months of this year. The average monthly imports in 1889 and 1890, before the M'Kinley Act was in operation, are also added by way of comparison:—

January	30,612,209lb.
February	42,338,245lb.
March	67,498,960lb.
April	70,489,102lb.
May	53,309,760lb.
Monthly average for 1889	60,662,164lb.
Monthly average for 1890	56,222,038lb.

The fourth annual meeting of the Namaqua Copper Company was held on the 28th ult. in London. The chairman, in moving the adoption of the report and accounts, stated that during the first three years of the existence of the company they had distributed no less a sum than £70,500 in dividends, besides making a good reserve fund, and it was therefore a matter of regret and disappointment to the directors to have no dividend in the fourth year to pass. As would be seen from the report, they had only been able in the past year to make a profit of £310 17s. 11d., which, added to the balance of £2435 1s. 8d. brought forward from last year's account, made a total of £2745 19s. 7d., which they proposed to carry forward. The motion was agreed to.

The Metal Market.

PRICES CURRENT.

LONDON, July 4.

COPPER opened flat in sympathy with weak advices from America, and prices receded 5s., but rallied afterwards on some buying orders being placed, and closed steady at a decline of 2s. 6d. from Friday's values. Cash made £44 12s. 6d. all day and three months ranged from £45 to £45 1s. 3d. Sales, 350 tons. Settlement price, £44 12s. 6d. English tough, £48; best selected, £49; strong sheets, £57.

TIN began firm and sharply rose 15s. above Friday's official quotations on good buying for three months' delivery. Cash also advanced 5s., but an easier tone supervened in the afternoon on some desire to realise, closing rates, however, being steady with cash unchanged from Friday, while three months finished at the opening improvement. Three months sold at £98 10s., and sharp cash at £99 15s.; but 11 days' delivery only made £98 17s. 6d., and four days' £99 5s. Sales, 125 tons. Settlement price, £99 10s. English ingots, £102.

PIG IRON has been inactive, but closed with buyers of Scotch cash 1d. over Friday's final rates. Hematite is unchanged, and Middlesbrough unquoted. Settlement prices:—Scotch, 41s. 3d.; hematite, 42s. 6d.

TINPLATES firm. I.C. coke, f.o.b. London, 13s.; Liverpool, 12s. 6d.; Swansea, 12s. 3d. per box.

LEAD, after business at £10 5s., closes quiet, with sellers of Spanish at £10 7s. 6d., or fully 1s. 3d., lower; English, £10 12s. 6d.

SPELTER steady, £21 15s. being paid for ordinary for July delivery. A fair business has been recently done in Silesian specials at £22.

ZINC.—Silesian sheets inactive; ordinary, ex ship, £24 5s., sellers. Belgian quiet. V.M. brands, ex ship, £24 12s. 6d.; export, £24 7s. 6d., sellers.

OFFICIAL CLOSING QUOTATIONS.

	£	s.	d.	£	s.	d.
COPPER—						
G. M. B.—Cash	44	12	6	45	0	0
" Three months	45	1	3	45	8	9
English tough		—		—		
Best selected		—		—		
Strong sheets		—		—		
TIN—						
Fine foreign, cash	99	10	0	100	0	0
" Three months	98	10	0	99	0	0
Australian, cash	99	10	0	100	0	0
PIG IRON—					s.	d.
Scotch warrants—Cash					41	3
" One month					41	5
Middlesbrough—Cash					—	
" One month					—	
Hematite—Cash					49	6
" One month					—	

GLASGOW, July 4.—Business was quite at a standstill on the pig iron market. There were no open dealings in Cleveland; but a number of lots were sold privately to the "bears" at 50s. There are still some accounts, it seems, to close, and these can only be arranged at 50s.; but for forward order there are said to be some offers on the market at 45s. There were five lots of Scotch sold at fully Friday's prices. Hematite is idle. The shipments of Scotch last week were 4585, being an increase of 350 tons on the corresponding week of last year, thus making the increase for the year 33,643 tons.

QUOTATIONS.

	Highest. s.	d.	Lowest. s.	d.
Scotch warrants—Cash	41	3	41	2½
" One month	41	5½	41	4
Middlesbrough—Cash	—		—	
" One month	—		—	
Hematite—Cash	49	6	49	6
" One month	—		—	

MIDDLESBROUGH, July 4.—The returns issued by the Cleveland Ironmasters' Association of the make and disposal of pig iron in the north-eastern district of England are again of a phenomenal character. There are now 76 furnaces in blast (against only three last month), this being only seven less than the total before the commencement of the Durham strike. There are now, however, only 38 on Cleveland iron, against 50 when the strike started, whilst there are 38 on hematite basic, and other kinds, against only 33. The make of Cleveland pig iron has been only 16,604 tons, a decrease on last June of 18,868 tons. The make of hematite, basic, and other kinds was 40,801 tons, an increase of 34,677 tons on May, but a decrease of 46,412 tons on June last. The total make of all kinds was 57,765 tons, a decrease on June last year of 155,280 tons. The stocks of Cleveland pig iron also show a remarkable decrease, and are lower now than for 20 years, the total stocks only being 48,472 tons, a decrease for the month of 39,491 tons, and for the year of 219,801. The decrease since the Durham strike started is 238,346 tons.

Trade Marks.

The following is the Official List of Applications published from June 22 to June 29, for the Registration of Trade Marks, so far as relates to the Metal Trades.

CLASS 5.

"The essential particulars of the Trade Mark are the following:—The representation of a racket and the word 'Racket,' and the applicants disclaim any right to the exclusive use of the added matter, except their name and address."

163,840. Unwrought and partly wrought metals used in manufacture. A. MURCOTT AND CO., 1, Helena-street, Parade, Birmingham, Warwickshire; merchants and manufacturers.—29th March, 1892.

CLASS 6.

"The essential particulars of the Trade Mark are the following—namely, the device and the word 'Porcupine,' and the applicants disclaim any right to the exclusive use of the added matter."

158,478. Steam boilers not for agricultural purposes. The HAZELTON BOILER COMPANY, 716, East 13th-street, New York, United States of America; manufacturers.—31st August, 1891. Address for Service in the United Kingdom, 28, Southampton Buildings, London, W.C.

CLASS 5.

"The essential particular of the Trade Mar is the device, and the applicants disclaim any right to the exclusive use of the added matter"

163,281—2795 S. Unwrought and partly wrought metals used in manufacture, including iron and steel. BLYDE, LEDINGHAM AND CO., Wallace Works, Furnival-street, Sheffield; manufacturers and merchants.—9th March, 1892. *By consent.*

CLASS 8.

"The essential particular of the Trade Mark is the device, and I disclaim any right to the exclusive use of the added matter."

163,844. Philosophical instruments, scientific instruments, and apparatus for useful purposes; instruments and apparatus for teaching, except articles of which the mark is a picture, and any goods of a like kind to such excluded articles. ANDREW HAMILTON BAIRD, 15, Lothian-street, Edinburgh; scientific instrument maker.—29th March, 1892.

CLASS 13.

164,803. Tube stoppers of metal, and all other articles included in Class 13. ASPLAN BELDAM, 77, Gracechurch-street, London, Middlesex engineer.—14th May, 1892.

CLASS 13.

164,305. Wire ropes and chains. GEORGE CRADOCK AND CO., 40, Denby Dale-road, Wakefield; manufacturers.—21st April, 1892.

The Official Gazette.

Partnerships Dissolved.

J. LUCAS and H. LUCAS, under the style of J. Lucas and Sons, Sheffield, steel and iron merchants; as far as regards H. Lucas.

BARLOW AND ALLINSON, engineers, Chapel-street, Salford.

THE BANKRUPTCY ACTS, 1883 AND 1890.

Receiving Order.

WILLIAM HERBERT HYATT, Harlington, chemical and scientific engineer.

Adjudication.

J. BARKER AND SONS, engineers, Phœnix Foundry, Todmorden.

Scotch Sequestration.

DONALD ROSS, metal and machinery merchant, 12, Waterloo-street, Glasgow.

Commercial Gazette.

☞ The name given is that of the defendant; the amount is that for which judgment was given, and the date is that on which it was given.

County Court Judgments.

WALLSEND STEEL AND WOOD BOAT BUILDING COMPANY, Wallsend Quay, £14 3s. 2d. 7th June.

WELSH, BRADSHAW AND CO., Mill Bay Pier, Plymouth, metal dealers, £16 18s. 5d. 1st June.

MESSRS. EKE AND CO., 9, Great Newport-street, Soho, London, engineers, £13 15s. 6d 2nd June.

New Companies.

WELSH ANTHRACITE COLLIERIES LIMITED.—This company has been registered with a capital of £100,000, in £1 shares, to acquire, hold, manage and improve lands, heritages, and real estates, and rights in lands, coal, iron, and other mines, and industrial properties of every description in the United Kingdom and elsewhere, and to carry on the business of colliery proprietors, miners, quarrymen, ironmasters, smelters, founders, engineers, etc. Registered by Messrs. Flux, Son and Co., 3, East Indian-avenue, E.C.

WILLIAM HARVEY AND CO. LIMITED.—Established to acquire and carry on the business of William Harvey and Co., lampmakers, ship chandlers, brassfounders, electrical engineers, etc., Glasgow. Capital £30,000, in £1 shares.

TRIPLE OIL AND COMPOSITION COMPANY LIMITED.—Formed, with a capital of £15,000, to purchase the freehold premises of the Triple Oil and Composition Company, situate at Belvedere, Kent, together with the goodwill and assets of the business carried on by the company, and to carry on the business of manufacturers of lubricating and other oils, composition for ships' bottoms, and of all descriptions of paints, enamels, and varnishes. The subscribers are:—Messrs. H. Baier, 27, Queen-street, Cheapside; A. Cooper, 44, Finsbury Pavement; W. Blakey, 57, Gracechurch-street; J. Harrison, 117, Leadenhall-street; G. Seymour, 4, Selsdon Villas, Barnes; E. Turner, St. Benet Chambers, 1, Fenchurch-street; and T. Black, 164, Suffolk House, London,

Letters to the Editor.

*** *We do not hold ourselves responsible for opinions expressed by correspondents.*

*** *The name and address of the writer (not necessarily for publication) must in all cases accompany letters intended for insertion, or containing queries.*

*** *Letters intended for publication in the current week's issue must reach our Manchester Office not later than by the first post on the Tuesday preceding the date of publication.*

DEVIATIONS FROM THE DRAWINGS IN THE WORKSHOP.

To the Editor of THE MECHANICAL WORLD.

SIR,—Will you kindly permit me the space in your columns to express my opinion upon the above subject?

I have carefully read the article, also the letter which appeared in your last issue in answer to it. I note the letter is signed "Both Sides," but I am inclined to think, from the tone of it, that the writer is one-sided, and that instead of healing a breach, which he claims is the object of his letter, it is more likely to open up a long discussion. The writer says: "I do not find a single suggestion as to how the existing relationship between shop and drawing office may be improved." If I read the article aright, it is not the writer's idea at all to *attempt* to suggest how the relationship can be improved, but he has kept to his subject, "Deviations from the Drawings in the Workshop," throughout the article. I certainly agree with what the writer of the article says, and could quote instance upon instance from my own experience where time and money have been entirely wasted through deviations from drawings in the shops without the drawing office being acquainted of such alterations at the time. An incident came under my notice only a few weeks ago, where drawings of newly-designed and standard work were sent into the shops. The drawings for cast-iron and smiths' work were issued, but when the finished drawing for the turners and fitters was sent out, the foreman came up and said he hadn't a knife tool for boring the size shown on the drawing, but had one ¼in. larger, and asked if it couldn't be altered so that he need not make a new tool. He got his way; the drawing was altered to suit him, which necessitated altering three or four other drawings, thus in every case the firm giving more metal in the casting, the brass bushing, and wrought-iron shaft, all for the sake of making one new tool, which would have come in for other jobs, and the cost of which would have been covered by the time wasted in hunting up shop drawings, making alterations, and the cost of extra metal put into the first set of work.

I wish it to be distinctly understood that I do not consider draughtsmen infallible. I quite agree with what "Both Sides" says, that "the letter might be infinitely prolonged by the introduction of examples of how foolish some draughtsmen and foremen are"; but, at the same time, I am bound to admit and express my opinion that as a rule you cannot get the manager or foreman to express his disapproval, or point out any slight improvement, while the drawings are in their early stage—viz., "when the ideas are all in pencil on paper." When reading this sentence in the letter, I wondered if "Both Sides" is or ever was a *draughtsman*. Because to sit down and write a suggestion on paper, and *imagine* the result, is a very different thing to putting it into actual practice. I have tried it more than once, and have had my patience tried as many times. I have, when getting out a new design for engine or machine work, gone into the shops and consulted manager and foreman as to the cheapest and easiest way for them to make and machine work. I have framed the ideas, and put them down on paper, and sent for the manager, foreman, or pattern-maker, as the case might be, to come up and look at same before proceeding further with the drawings, and in nine times out of ten they have had nothing to suggest. The drawing is traced and passed on to the manager or foreman, with the result that repeatedly I have noticed it is brought back again to have some trivial alteration made in some detail of forgings, saving perhaps a penny in the smiths' shop, and, in many cases, costing 2d. or 3d. more for fitting, and often not making so good a job. I have asked why they did not mention such alteration before the drawing was finished, and have had in reply from both manager and pattern-maker, that "they cannot think it out until they have the tracing in their own office to themselves."

ONE WHO HAS EXPERIENCED BOTH SIDES.

Ipswich, June 28.

FOREIGN SEWAGE PRECIPITATION WORKS.

To the Editor of THE MECHANICAL WORLD.

SIR,—Referring to the report contained in your issue of the 17th inst., of my paper on "Foreign Sewage Precipitation Works," read by me before the Society of Engineers on the 13th inst., the following is from a letter just received by me from Mr. Lindley, of Frankfort:—"In THE MECHANICAL WORLD of June 17, I find your paper on 'Foreign Sewage Precipitation Works.' There is a slight mistake, which I shall be glad if you would have corrected at once, as I should be sorry if it got copied into other papers. The sentence should run thus:—'The system of water-closets, drains and sewers was commenced 25 years ago, under the direction and according to the plans of Mr. W. Lindley [not W. H., and not the *late*, as I am thankful to say my father is living, hale and well, at Blackheath], and completed by his son, Mr. W. H. Lindley, the present engineer-in-chief of the city.'"

You would greatly oblige, sir, by inserting the above correction.

ALBERT WOLLHEIM, C.E.

Leadenhall House, E.C., June 28.

TRIAL OF S.S. "PEREGRINE."

To the Editor of THE MECHANICAL WORLD.

SIR,—In your issue of the 17th inst., under the heading of "Shipbuilding Notes," you made mention of the splendid results of the trial trip of the s.s. "Peregrine," built by Messrs. W. B. Thomson and Co., of Dundee, for the General Steam Navigation Company, London, and where 17·2 knots per hour was obtained. We should like to point out that Magnolia metal is used throughout all the bearings of this steamer, and has been used exclusively by Messrs. Thomson and Co. for some time past in all the engines they build, both marine and land.

THE MAGNOLIA ANTI-FRICTION METAL COMPANY OF GREAT BRITAIN.
E. F. STANLEY, *Director.*

Manchester, June 28.

BIRCH'S SCREW-CUTTING LATHE.

To the Editor of THE MECHANICAL WORLD.

SIR,—Referring to the notice in your issue of the 1st inst. of a screw-cutting lathe made by Messrs. G. Birch and Co., which concludes, "The makers' reputation is sufficient guarantee of the excellence of the general *design*," I think it only fair to point out that—excepting a few matters of minor detail—Messrs. Birch's lathe is apparently an exact reproduction of a type formerly made by Astbury and Dawson, Grantham, and of which an illustration appeared in THE MECHANICAL WORLD as far back as *July 27, 1883.*

W. H. ASTBURY.

Grantham, July 4.

Miscellaneous Items.

The postage to be prepaid on letters addressed to all destinations outside the United Kingdom, without exception, has now been fixed uniformly at 2½d. the ½oz.

A buoy at South-west Spit is now lighted by electricity, the necessary current being conveyed by means of a submarine cable, two miles long, connected with the generating station on Sandy Hook, U.S.A.

The Dominion Senate (Canada) has passed a bill to amend the Patent Act, to extend the life of a patent from 15 to 18 years, and to do away with the necessity for models. The bill was introduced at the request of the Canadian Inventors' Association.

The Canadian Pacific Railway Company notifies a half-yearly dividend at the rate of 5 per cent. per annum, payable on August 7. Of this dividend 1½ per cent. is from the annuity provided for by a deposit with the Canadian Government, and 1 per cent. is from the surplus earnings of the company.

The Western Countie and South Wales Telephone Company have decided to amalgamate with the National Telephone Company.

Last month 49 steamships were added to the register for the United Kingdom, while 18 only were removed thence. On the other hand, 35 sailing vessels were added, whilst 47 were removed, so that the merchant navy is being turned continuously into one steam-impelled.

The progress of shipbuilding from the earliest times up to the present will be shown by a very extensive exhibit at the Chicago Exhibition which will be made by Laird Bros., of Birkenhead. The firm's exhibit of like character at the recent English naval exhibition attracted a great deal of attention.

A new pavement is being brought out in the United States. Its foundation is steel plates laid in sand. These plates are 3ft. long by ¼in. thick, and strong enough to stand a tensile strain of 50,000lb. to the inch. They are flanged on the side and laid from curb to curb across the street. The flanges are pinned together, and the plates perforated for drainage.

A seam of peat has been found underlying the London clay near the Isle of Dogs. It was very wet, and darkened on exposure. The seam contained branches and trunks of trees, and varied in thickness from 2—6ft. The dried material contained half its weight of ash, and therefore could scarcely be looked upon as a promising fuel. The ash was composed of 62 per cent. of silica and 21 per cent. of alumina and ferric oxide, the balance being chiefly calcium carbonate.

A new mineral, not unlike asbestos in its properties, has been discovered in immense deposits in the United States of Columbia. It is stated to be the colour of amber, perfectly transparent, and incombustible. Experiments made at Bogota indicate that it will be of great value for the manufacture of bank-note paper, for fireproof and waterproof roofing tiles, and for suits for firemen. A white varnish can also be extracted from it. The substance has been named bucara-manquina, and it is expected to prove of greater importance than asbestos.

An incombustible paint or varnish for hot-air conduits is obtained by mixing yellow talc with some heavy mineral oil in sufficient quantity to form a mixture which can be well held by a brush. The tubes or conduits to be treated are given a thick coat of this varnish, and are then treated in a furnace, this two-fold operation of varnishing and baking being repeated several times if necessary or desirable. The coating is said to adhere very well, to give off no odour when the conduits become hot, and to admit of being highly polished by rubbing with a greasy rag.

It is only seven years since the first electric railway was put into commercial operation in the United States. On January 1, 1888, there were only 48 miles of electric roads in operation, while in 1891 there were 2893. According to the U.S. census of 1890, there were then 8123 miles of street railway tracks in the United States, carrying 2,023,010,202 passengers annually. This figure is almost five times the number carried on all the interurban steam railroads. 1,500,000 passengers are said to be carried daily by all the electrical roads, the number of car miles being about 400,000 per day. The last two figures are, however, probably too high. In September, 1891, the sub-division of the various street railways was as follows:—5442 miles operated by animal power, 3000 by electricity, 1918 by steam, and 660 by cable; 1003 roads use animals, 412 electricity, and 54 cable. The diminution in the number of horses in one year was 28,681. England has only 29 miles of electric railroads. The number of passengers carried per year in Philadelphia is given as about 150,000,000, or over 100 rides per inhabitant. The elevated roads in New York carried 400,000,000 passengers. Philadelphia has 510 miles of track, or, with the exception of Chicago, which has 452 miles, it has almost twice as many miles as any other city in the country.

It is best to test cement briquettes at least 30 days after their manufacture. Baron de Rochmont, engineer to the Port of Havre, gives figures to show that the strongest briquettes, at two days, having a breaking strain of 147lb. to the square inch, had a breaking strain of 318lb. per square inch. Other cements which had breaking strains of 157lb. at two days increased to 661lb. in 30 days. The weight and tensile strength of cements diminish when they have been kept in stock for some time. In the case of 15 cargoes of cement which came under his notice, the weights, on delivery, were between 111—121lb. per bushel, and the breaking strains were from 75—160lb. per square inch in two days, 160—289lb. in five days, and 339—460lb. in 30 days. After being six months in store their weights were from 101—108lb., and their breaking strains from 38—114lb. in two days, 112—195lb. in five days, and 234—340lb. in 30 days. The fall in weight and strength when the cement has been kept in store for a year is still greater. One cargo weighed on delivery 111lb. per bushel, and its breaking strains at two, five, and thirty days were 96, 236, and 371lb. respectively. After the cement had been in store six months its weight was 106lb. per bushel, and the briquettes made from it had breaking strains at two, five, and thirty days of 109, 178, and 332lb. respectively. After being in store a year the cement weighed 106lb. per bushel, and the briquettes made from it had breaking strains at five and thirty days of 73 and 250lb. respectively.

The French postal authorities have decided to issue a post-card at a cost of 80 centimes (8d.) for the use of inventors, etc., requiring patent specifications. On receipt of a post-card giving the number of the specification required, this will be sent post free.

The publisher of "The Mechanical World" will send a prepaid parcel of specimen copies to anyone, in any part of the world, who can distribute them advantageously amongst his engineering friends. Business card or bill-head should be enclosed as a guarantee of good faith, and number of copies stated.—Address: 391, Strand, London, or New Bridge-street, Strangeways, Manchester.

Prize Competition.

WE OFFER FOUR GUINEAS MONTHLY IN PRIZES FOR THE BEST ORIGINAL ARTICLES SENT IN ON ANY MECHANICAL, ENGINEERING OR ELECTRICAL SUBJECT.

IN ORDER THAT MANAGERS, DRAUGHTSMEN, FOREMEN, AND WORKMEN WHO HAVE HAD NO PRACTICE IN WRITING MAY NOT HESITATE TO SEND IN COMPETITIONS, IT IS TO BE UNDERSTOOD THAT ALL ARTICLES WILL BE FULLY EDITED AND CORRECTED, AND JUDGED OF SOLELY ON THEIR MERITS AS ORIGINAL CONTRIBUTIONS FROM A PRACTICAL POINT OF VIEW. THE OBJECT OF THE COMPETITION IS TO INDUCE PRACTICAL MEN TO COME FORWARD AND GIVE THE RESULTS OF THEIR EXPERIENCE.

CONDITIONS.

Competitions for our Monthly Prizes must be sent so as to arrive at the Manchester Offices of THE MECHANICAL WORLD, New Bridge-street, not later than the last Tuesday in each month. Articles arriving after that time will be placed in the following month's competition.

Written competitions must be on one side of the paper only. The contributions must be original, and relate to matters connected with Engineering, Mechanism or Electricity.

The Proprietors of THE MECHANICAL WORLD reserve the right to publish any competition, whether it gains a prize or not.

The competitions may be accompanied by diagrams, sketches or drawings.

Competitors should write the words "Prize Competition" on the envelopes.

Competitors are not confined to one, but may send any number of competitions.

The correct name and address of the sender *must* be distinctly written upon every competition, not necessarily for publication. Competitions can appear under a *nom de plume.*

☞ We cannot undertake to be responsible for any MSS. sent to us, though when stamps are enclosed for the purpose we will endeavour to return rejected contributions.

Queries.

☞ Readers are invited to avail themselves of this section for practical information on questions relating to Mechanical Engineering and the Scientific Industries.

☞ Queries and Replies should arrive at the Manchester Office not later than by the first post on the Tuesday preceding the date of publication.

NICKEL.—In an alloy of cast iron and nickel what is the increase in strength over cast iron, and what proportion of nickel should be used?—T. C.

ALUMINIUM.—Will any reader inform me what is the greatest percentage of metal alumina has been found to contain up to the present date?—ALUMINA.

ECONOMISER SCRAPERS.—What means must I adopt to renew some broken scrapers in the middle of the range of pipes in the economisers?—PUZZLED.

PATTERNMAKER'S TOOL BOX.—Will any reader give me a sketch of the patternmaker's tool box, with full dimensions and particulars?—APPRENTICE.

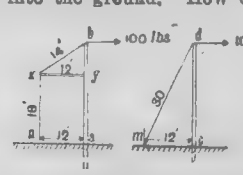
RIFLING MACHINE.—I should be glad of a sketch of any appliance used for rifling out small barrels, such as revolvers, etc., say ¼in. to ⅜in. bore, with threads, say, 6in. pitch.—NEMO.

FEED-WATER HEATER.—Could anyone kindly give the square feet of heating surface for a 6in. feed-water heater, or the best allowance per I.H.P. of engine? What is the usual amount in a first-class heater, say Atkinson's or Berryman's?—P. H. S.

HOT-AIR ENGINE.—Will some reader of THE MECHANICAL WORLD kindly oblige me with a section and principal dimensions of a ½H.P. single-acting hot-air engine of the Stirling cycle?—GEO. H. PERKINS, North Queensland.

LINING BRASSES.—I have some brasses to line up with Babbitt's metal. Will some reader kindly tell me if they are cast in a sand box and turned up, or filled up around the journal, and what should be applied to keep the metal from adhering to the journal?—BABBITTS.

STAYING TELEGRAPH POSTS.—*a b* and *c d* are two telegraph posts of equal height, firmly fixed into the ground. How can *m d* be



proved to be a stronger way of staying than *n x b*? Also, what is the compressing thrust on the strut *x y*, and the bending moment about *y*?—TELEGRAPH POST.

WATER FLOWING INTO JET CONDENSER.—Will some fellow-reader kindly give me a worked-out example of the quantity of water that will flow through a 4in. pipe 30ft. long, with four bends, into a jet condenser with 18in., 24in., and 28in. of vacuum; wheel valve wide open, giving same area as pipe; also with it half open? The water supply tank is 8ft. below condenser. The condenser is working on a set of triple-expansion engines. What effect have bends and temperature on supply water?—SUGAR MILL, North Queensland.

MAKERS OF CELLULOID.—Required the names and addresses of extensive makers of celluloid.—B. P.

COLLIERY HAULAGE PLANT.—I should be very pleased if some reader would give me some information on the following subject. In laying down a plant for endless rope haulage at a colliery the following data are given:—The engines are fixed at the pit bank, at a distance of 20yds. from the shaft. The shaft is 200yds. deep. Ropes are carried down shaft in wooden boxes. Said ropes are 1¼in. round steel. From the pit bottom the haulage extends a distance of 3000yds. Starting at the end farthest from the pit bottom, the road rises 1 in 20 for 300yds., then 1 in 14 for the next 200yds., then it is level for 100yds., then a fall towards the bottom of 1 in 30 for 200yds., then a rise of 1 in 5 for 300yds. and the remaining 1900yds. has a rise of 1 in 21. The speed of the rope is 1½ miles per hour. The weight of the corves is (empty) 4cwt., and each corf contains 8cwt. These are hung on the ropes in pairs at a uniform distance of 10yds. apart. The empty corves are hung in the same way. The driving pulley on engine to be about 6ft. diameter. The boiler pressure is 50lb. The rope runs over the corves, and in the 3000yds. each rope has 10 holding-up pulleys. What I should like to know is how to calculate the H.P. required to run the haulage; also how to calculate the size of engines and gearing to develop a H.P. having sufficient margin for same; also what margin is necessary? In this arrangement the road is pretty straight. What difference would it make to the power required, supposing there is a curve in the roads containing an angle of 135°?—NOVICE.

Replies.

☞ **Owing to the constant increase in our correspondence we regret that we have no alternative but to announce that we cannot reply by post to Queries even when stamped envelopes are sent.**

☞ **Queries and Replies must in all cases be accompanied by the names and addresses of the writers, as no notice will be taken of anonymous communications.**

CELT.—Apply to Messrs. John Sutcliffe and Sons, New Bank, Halifax.

E. PLURIBUS UNUM.—We hope to include the matter referred to in the series.

ONE IN A FIX.—Bottone's "Electric Bells," 3s., will suit you. It may be had from our office.

HAMMER.—We cannot tell. Your best plan is to search the name indices of patent specifications.

J. ROBUTSHAW.—We shall require a full sketch of the whole arrangement before we can assist you further.

MIDLAND.—Particulars such as you require would occupy too much space. You will find full directions and particulars in Bonney's "Electro-platers' Handbook," 3s., which may be had from our office.

PAPER MACHINE.—(1.) We think Messrs. Urquhart, Lindsay and Co., Dundee, or Messrs. Bentley and Jackson, Bury, will be able to meet your requirements. (2.) THE TEXTILE MANUFACTURER was established in 1875.

R. A. H. P.—We are perfectly familiar with Unwin's "Machine Design," but we are certainly unable to find any mention of the coupling referred to. It appears to us that you have become somewhat mixed in your ideas. Try again.

POLISHING MACHINES.—Required the name and address of makers of machines for grinding and polishing copper plates.—POLISHER. —*A.*—If "Polisher" will communicate with Mr. Thomas Smith, Field-place, Stoke-on-Trent, no doubt he will obtain all the information he requires. —*A.*—Mr. R. W. Eden, Derby-terrace, Hindley, near Wigan, will be pleased to communicate with "Polisher."

CONICAL TANK.—A tank in the form of a conical frustum is made 12in. deep, to hold 13 ale gallons when full; the diameters are to be in the proportion of 5 to 3. Will any reader give a rule or formula to find the diameters? —MECHANIC.—*A.*—The volume V of a conical frustum is given by the following formula:—

$$V=\frac{\pi h}{12}(D^2+d^2+Dd),$$

wherein h is the height, D and d the respective diameters of the bases; $\pi=3{\cdot}1416$. Let $\frac{D}{d}=k$. Then $D=kd$, and $D^2=k^2d^2$. The formula then becomes—

$$V=\frac{\pi hd^2}{12}(k^2+k+1)$$

hence

$$d=\sqrt{\frac{12V}{\pi h(k^2+k+1)}}.$$

And after numerical simplifications,

$$d=1{\cdot}9544\sqrt{\frac{V}{h(k^2+k+1}}.$$

In the case under notice

$$V=13\times277{\cdot}274=3604{\cdot}562 \text{ cub. in.}$$

$h=12$in., and $k=\frac{5}{3}=1{\cdot}666$.

Then

$$d=1{\cdot}9544\sqrt{\frac{3604{\cdot}562}{12(2{\cdot}775+1{\cdot}666+1)}}=14{\cdot}52.$$

The small base is 14·52in. in diameter, and the large one $14{\cdot}52\times\frac{5}{3}=24{\cdot}2$in. A greater approximation may be obtained, but I think this will be accurate enough to make one base 14½in. in diameter, and the other 24¼in.—H. GOBERT.

EXPANDING RIMERS.—Will some practical reader kindly give me any information regarding expanding hand rimers, for use on the bench, say for rimering cast or wrought-iron holes in sizes from ½in. to 1in. diameter? I have tried several sorts, but they are far from perfect.—J. W. C.—*A.*—I have recently had an opportunity of examining and using several rimers as J. W. C. is inquiring for, and one or two certainly without the faults possessed by the ordinary general use. When worn under size the cutting edges are touched up with an oil stone, and then set at one operation to a muff accurate as close as the $\frac{1}{1000}$th part of an inch in a minute. The cutters will take ½in. or more in the 1½in. size, and when worn so far can be used again for the next size smaller. With such a rimer there is no excuse for holes being under size. The tool shown to me is I believe patented by the manager of the works in which it was in use and doing good work. I am unable to say if it is in the market, but will inquire and send further particulars if possible.—W. A. S. C.

Latest Inventions.

APPLICATIONS FOR LETTERS PATENT.

When Patents have been "communicated," the name of the communicating party is printed in italics.

Where complete specification accompanies application, an asterisk is suffixed.

20th June, 1892.

11,463 FASTENERS for BELTS and STRAPS. A Timpe.
11,466 TUBES for STEAM BOILERS. R W Boyd. (*J W Boyd*, China.)
11,471 RAILWAY SIGNALLING. C Brown.
11,487 ERECTING TOP and MIDDLE SECTIONS of TELEPHONE POLES. R F Jeffries.
11,498 STEAM PUMPS.* J Y Johnson. (*J Belleville*, France.)
11,500 BRAKE APPARATUS for TRAVELLING CRANES. J Keeling.
11,503 HIGH-SPEED FLUID-PRESSURE ENGINES. C H Benton.
11,504 OBTAINING OXYGEN and NITROGEN from ATMOSPHERIC AIR. L Chapman.
11,507 COMPOUND GEAR for VARYING SPEED. T Thorp and C Wood.
11,508 DITCHING MACHINE. J J Wishard.
11,511 MACHINES for CARVING WOOD.* A H Tyler and J S E de Vesian.
11,513 SAFETY VALVES. R C Anderson
11,518 DRIVING BELTS and PULLEYS. G Smith.
11,525 APPARATUS for MANUFACTURING ELECTRIC CABLES. G G M Hardingham. (*Felten* and *Guilleaume*, Germany.)
11,526 ELECTRIC CABLES. G G M Hardingham. (*Felten* and *Guilleaume*, Germany.)
11,527 BALANCING the FORWARD THRUST of the PROPELLERS of SCREW STEAM SHIPS. T Inglis.
11,528 DYNAMO ELECTRIC MACHINES. J A C Ziegler and others.
11,531 DRAWING COMPASSES. W P Thompson. (*M Ullmann*, Germany.)

21st June, 1892.

11,537 SAND SHIFTING MACHINE for FOUNDRY PURPOSES. J P Hall and T Glover.
11,538 INDEPENDENT CONTROL and SLIDE PLATE REDUCING VALVE.* J M Nisbet.
11,539 REMOVING DIRT or SCALE from NARROW SPACES. J B Burrell.
11,547 BRICK-MAKING MACHINES.* J W Mackenzie. (*Muhlenbauanstalt Maschinenfabrik* and *Eisengiesserei*, Germany.)
11,548 LUBRICATORS USED on DYNAMO-ELECTRIC MACHINERY. C S Snell and Woodhouse and Rawson United Limited.
11,549 SHIPS' RECORDING COMPASSES.* W E Heyes. (*The Townsend Marine Invention Company*, United States.)
11,550 COMPOUND STEAM ENGINES.* B W Burnet.
11,555 WRENCHES.* E W Rider.
11,560 VACUUM PUMPS.* J W Fraser and J D Wilson.
11,569 MECHANISM for TRANSLATING RECIPROCAL and ROTARY MOTIONS.* W E Heys. (*A Kircher*, Germany.)
11,573 FEED PUMPS for STEAM ENGINES. A Blechynden.
11,586 WATER CIRCULATING DEVICES for STEAM BOILERS. P Pinckney.
11,588 FORCED-DRAUGHT APPARATUS for STEAM BOILER FURNACES. J Hill.
11,592 OPERATING AMMETERS and OTHER ELECTRICAL APPARATUS. C K Mills. (*H M Pilkington* and *R S White*, United States.)
11,595 AUTOMATIC FURNACE DAMPER REGULATORS for HOT WATER HEATING SYSTEMS.* W P Thompson. (*L F Smith*, United States.)
11,596 OIL MOTOR ENGINES. M Mercier and F Boddington.
11,598 TRAMCARS and MOTORS THEREFOR. W P Thompson. (*J M O'Kelly*, United States.)
11,599 HYDRAULIC PRESSURE ACCUMULATORS.* W W Sutcliffe.
11,601 CHECK VALVES.* M Laspeyre.
11,603 MACHINERY or TOOLS for TURNING, SHAPING, and PLANING.* E G Brewer. (*K A Windmüller*, Germany.)
11,606 MANUFACTURE of IRON and STEEL. F Siemens.
11,615 APPARATUS for HEATING and PURIFYING FEED-WATER and DRYING STEAM.* J Y Johnson. (*J Belleville*, France.)
11,617 DYNAMO MACHINES. C J Hall.
11,618 CORNISH BOILERS.* R Müller.
11,624 COIN-OPERATED TELEPHONE APPARATUS. H H Lake. (*E Noriega*, Mexico.)
11,630 COMPOUND STEAM ENGINES.* H H Lake. (*J N Gamble*, United States.)
11,631 STEAM ENGINES.* H H Lake. (*J N Gamble*, United States.)
11,634 ELECTRIC RAILWAYS. F Wynne.
11,635 HYDRO-CARBON ENGINES or MOTORS. D Young. (*J Berlize*, Belgium.)
11,640 ELECTRIC METERS. F H Nalder and others.

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11,683 SEPARATING MAGNETIC ORE from SAND. W B Basset.
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11,742 EXTRACTORS for STUFFING-BOX GLANDS and FERRULES for BOILER TUBES. T K Wilkes.
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11,762 IGNITION APPARATUS for GAS and OIL MOTORS. E W Cooper and R H Lea.
11,773 EMERY WHEELS.* H H Lake. (*A Johnston*, United States.)
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11,779 CARBONS for ELECTRIC ARC LAMPS.* G F Redfern. (*C Braun*, Germany,)

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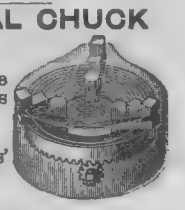
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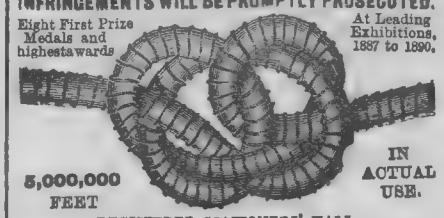
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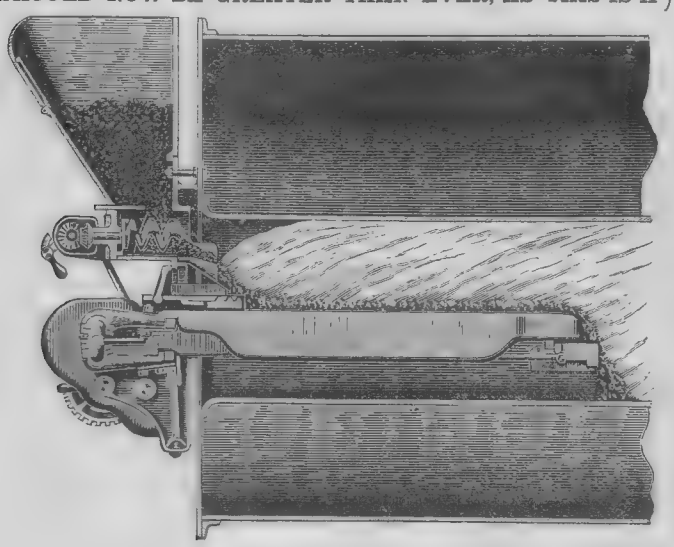

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FRIDAY, JULY 15TH, 1892.

Storage Batteries in Railway Work.

IT is proposed by the Baltimore and Ohio Railroad Company to move the trains in the Belt Line tunnel at Baltimore by means of two electric locomotives. This experiment is to be made so as to get rid of the smoke, and will necessitate the erection and equipment of a large generating station. In this connection Mr. A. Macrae brings forward a somewhat novel suggestion, which he contends would effect a considerable economy over the projected installation. Instead of erecting a special generating station, he suggests that the current should be obtained from the electric-light stations which are situated half-a-mile from the tunnel, and that this should be utilised for charging storage batteries from which the electro-motors on the locomotives would be energised. The batteries in this case would be located in the tunnel. Mr. Macrae considers that by the use of storage batteries arranged at different points along the route and charged from light and power stations already existing, electric railways could economically encroach more and more on the domain of steam lines. Natural sources of power, says Mr. Macrae, would become much more available for the type of railway motors now used, and the dynamos in lighting stations could be kept in almost constant service instead of being allowed, as at present, to sleep all the summer days under canvas covers. It will be evident that the author of this scheme argues that better results would be obtained by the use of storage batteries than by the employment of the direct current. This is of course only a supposition, but there is no doubt that electric-light stations would become more remunerative undertakings provided the plant could be operated at full load instead of being run at varying loads, as now obtains, and Mr. Macrae's suggestion is therefore worthy of careful consideration.

Vulcanised Timber.

THE importance of preserving timber from decay, especially when used in structural work, for railway sleepers, etc., has long been recognised, and various processes have been introduced from time to time to effect this object. Of these processes one of the latest is due to Colonel Haskin, of the United States, who, having had considerable experience in creosoting timber, came to the conclusion that if he could retain the natural antiseptics contained in the wood, instead of depleting the timber of them and then partially reintroducing them, he would arrive much more quickly at a cheaper and more satisfactory result. Accordingly his process consists simply in placing the timber by small wagon loads in an air-tight retort and subjecting it to high-pressure superheated air, the temperature of which varies from 300 to 700 degrees. The time of exposure to the heat varies with the character of the timber, ordinary wood requiring about eight hours, and the hard woods used for decorative and similar purposes requiring from 10 to 20 hours to vulcanise. The heat is found to permeate the whole section of all the timber in the retort, thereby accomplishing the same result as the charring process, only in a much more thorough and efficient manner, without losing any of the sap or chemical properties of the wood, and without waste. The process, however, goes further than this, inasmuch as the high temperature kills all the germs that may be found in the chemical properties of the timber which tend to breed and nourish bacteria. In short, the effect of the process is to solidify the albumen or life property of the tree, and at the same time to destroy bacteria or fungi, thus preserving the wood against decay. Another important result is attained in that the wood becomes harder and stronger. Professor Alfred P. Trantwein, of Stephen's Institute of Technology, Hoboken, New Jersey, who has extensively tested vulcanised wood in this connection, reports that his experiments establish the fact that vulcanising strengthens the wood, the modulus of rupture by transverse stress being 21 per cent. higher, and the crushing strength being increased 23 per cent. A syndicate has been formed to put down plant and machinery for working the process in this country.

Electric Signalling from Balloons.

AT the Inventions Exhibition held a few years ago, there was shown for the first time a model of a system of electric signalling from balloons. That method was subsequently tested by the English and other Governments so as to demonstrate the practicability of the invention. Since then the system, which is due to Mr. E. Bruce, F.R.M.S., has been developed, and several improvements, particularly as regards reduction in the weight of the apparatus, have been introduced. Demonstrations of the method were given last week in the presence of a distinguished assembly. The balloon is made of a perfectly translucent material, and has arranged inside six incandescent lamps of 16C.P. The balloon is, of course, captive, and is secured by ropes in the usual manner. The lamps are energised from a battery of 26 cells, arranged on the ground, the current passing to and from the balloon by means of two conductors formed into one, but insulated from each other. The lamps are arranged on a special holder, and by means of signalling keys it is possible to signal according to the Morse or any other code, the making and breaking of the circuit being rapidly effected. The employment of this system renders easy of accomplishment signalling to long distances at night, and in those places where the ordinary method is out of the question. This system of flashing lights inside the balloon is supplemented by a contrivance for flashing lamps outside the balloon. Each arrangement has its advantages according to the condition of the atmosphere, and in addition to being of great utility to the military authorities, the system is applicable to the navy and for coastguard signalling.

Compressed Air Motors.

FROM an account of the working results of the compressed air street railway at Berne, Switzerland, given by the chief engineer of the line, it would appear that, on the whole, they have been quite satisfactory. The length of line operated is about 1¼ mile, built at a total cost, including rolling stock and all necessaries, of about £19,150. The number of passengers carried during the past year was 1,146,532, and the receipts amounted to 118,935 francs, of which about 83 per cent. went to cover the working expenditure. The principal difficulty thus far encountered in operating the road was due to the extremely cold weather during the winter of 1890-91, which caused freezing of the air mains and consequent ice stoppage. The mains were thawed out by means of hot sand. Since then the mains have been covered with a non-conducting covering, and a second air-supply main has been laid from the compressor station to the charging station. The new main has a rise of one in twenty, in virtue of which the water of condensation drains off rapidly without making traps necessary, and it is thought that in the future, however cold the weather may become, no further trouble from freezing will be experienced. An early extension of the system is in contemplation.

Carbonic Anhydride Refrigerators.

A SYSTEM of refrigeration has been introduced into this country by Messrs. J. and E. Hall, of Dartford, the machine working on the carbonic anhydride system. It consists of three parts—the evaporator, the compressor, and the condenser. The liquefied carbonic acid is evaporated in the evaporator, which consists of a series of coils surrounded by brine. It is then drawn into the compressor and raised to the liquefaction pressure. It then condenses into a liquid within the coils of the condenser, whence it flows into the evaporator, and so on in a closed cycle. The evaporation of the liquefied carbonic anhydride cools the brine surrounding the evaporator coils to within a few degrees of itself. The brine thus cooled circulates in the freezing rooms, cold stores, or between the ice moulds in ice factories, abstracting the heat from the water or the goods to be frozen. These machines are said to effect the same work as the older dry-air refrigerator on one-seventh the coal consumption and with one-fifth the weight of machinery. There is no danger attending the use of these machines, carbonic acid gas being inodorous and non-poisonous.

The Bridgnorth Inclined Railway.

BY the opening last week of the Bridgnorth inclined railway, communication between the high and low portions of the town of Bridgnorth has been greatly facilitated, as until recently the two sections of the town were separated by a flight of some 200 steps and long sloping paths. The gradient or inclination of the track, which is the steepest in England, may be popularly understood by defining it as a rise of 1ft. in a horizontal length of about 1½ft., and the cutting has a vertical depth at one place of about 50ft., cut entirely out of the solid rock. The length of the track is 201ft., and the vertical rise or lift is 111ft. The system of working the inclined railway is that generally employed, water being led into a tank under one car when at the top of the track, to overbalance and draw up the companion car at the bottom of the track. The two cars, each capable of carrying 18 passengers, run on independent pairs of rails, and are securely connected to each other by two steel wire cables, each of which is of ample strength to do the whole work. The steel rails are secured to sleepers bolted down to the solid rock, each sleeper being also held in position by being embedded into concrete blocks. Water is pumped from the bottom to the top tank by means of a pair of double-acting horizontal pumps, driven independently by a pair of the latest type "Forward" gas engines. The safety of the passengers has been provided for, the rope for connecting one car with the other being duplicated. There are two steel wire cables, each capable of sustaining a load 15 times in excess of that which has to be brought on to the cars before breaking. Beyond the question of duplication and extra strength, automatic wedge brakes come into action in the event of either, or, what is impossible, both of the ropes breaking. Brakes also come into play if too great a speed is attained, and instantly arrest the motion of each car by gripping the rails on all four sides. The distinguishing feature of the system of working, and one which should satisfy the most timid of passengers, is that the cars cannot run down the incline by themselves, but that if left untouched they will stop perfectly still. It is only when both brakesmen wish the cars to go that they can move. The act of turning the hand-wheel on each car raises the weight which is normally pressing on to the water to convey pressure to the hydraulic cylinders connected to each brake gripper. During the journey of the cars, should either of the brakesmen release their hold upon the hand-wheels, the cars would instantly stop.

On the Use of Mild Steel.*

THIS is a report of the committee nominated by the Aachen section of the Society of German Engineers to consider the subject of steel in reference to recently developed processes, and its consequently extended adoption for purposes of construction. The committee state that they have thought it advisable to confine themselves to general questions and conclusions.

The first point considered was: Is soft or hard steel preferable, under general conditions, for building purposes; what are the limits of strength which it is desirable to specify, and are any further tests required? The committee state that, generally speaking, soft steel is to be preferred. For ordinary commercial and industrial purposes, the tensile strength should be between 23·45 and 28·60 tons per square inch, the minimum extension 20 per cent. (in test bars 8in. in length), and the coefficient of quality (resistance and extension) 598. For bridge work the tensile strength should be between 23·45 and 27·30 tons per square inch, and coefficiency of quality 572. It is not considered advisable to specify any chemical analysis, as the physical properties afford a sufficient index to the composition of the metal, and the result depends not only upon the quantitative identification of the component substances, but also upon their mechanical combination.

In considering if it is advisable to specify not only the class of material but also the precise method and conditions of its production, the committee are of opinion that the specification must be limited to such general normal conditions for the identification of quality as can indubitably be conformed to, and that any minute limitations are technically impracticable and without result, and commercially injurious.

As to whether any further precautions are necessary in the manipulation of steel (that is, in addition to the methods of working of wrought iron), the only point to be noted is that, unless unavoidable, the material shall not be worked when in the condition of blue heat.

The committee finally considered whether any increase in working loads is admissible, and if so, to what extent; and upon this point they are decidedly of opinion that the working load can be increased by 6·35 tons per square inch for live loads, and 7·62 tons per square inch for dead loads.

* Inst. C.E.: Foreign Abstracts.

The Design and Construction of Stationary Engines.—XXXII.

[ALL RIGHTS RESERVED.]

THE type of engine known as the "trunk" or girder engine is largely employed by makers of Corliss engines and others, the guides for which are cast as part of the frame, the sliding surface being bored out or planed truly with the axis of the cylinder, as in Fig. 154. This is a very neat and stiff arrangement, allowing of the engine being run in either direction as may be desired. Figs. 155, 156, and 157 are cross sections of girder frames by Continental makers. It will be noticed that the section adopted is really a rail or I section. In one case the sliding surface is circular, struck from a comparatively small radius, whereas in the other the circle is struck from the centre of the frame. Fig. 156 shows V guides, an arrangement which is adopted by some Continental and American makers. In our opinion it offers no advantages over a flat or bored surface, and must be more expensive to machine. Fig. 158 is a cross section of a similar style of guide, the top surface being machined flat across, the bottom surface being recessed under to give side guidance.

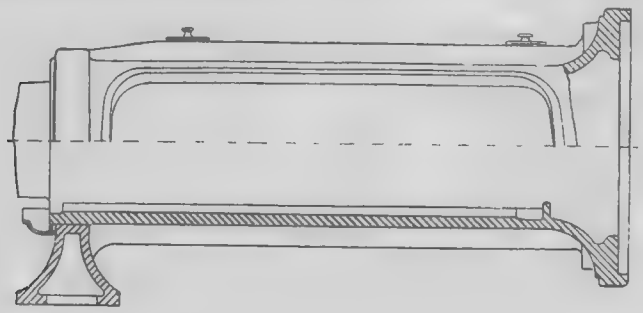
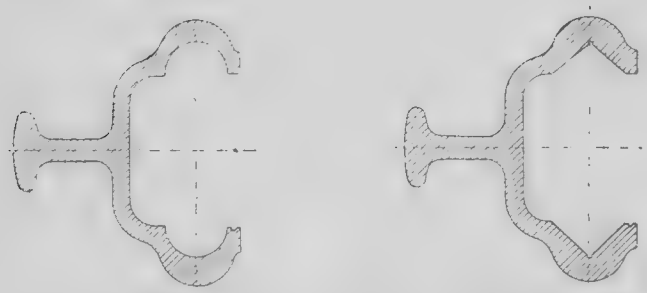


FIG. 154.



FIGS. 155 AND 156. DESIGN AND CONSTRUCTION OF STATIONARY ENGINES.

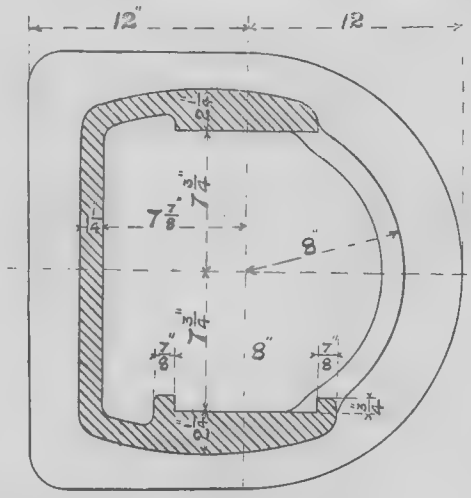


FIG. 158.

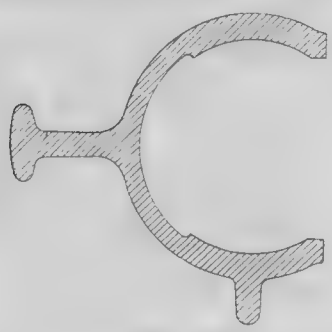


FIG. 157.

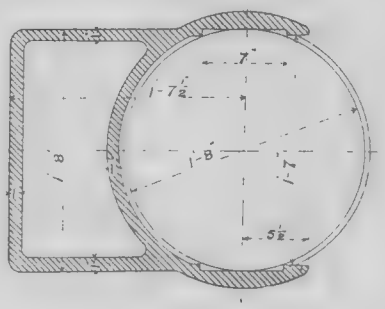


FIG. 159.

Fig. 159 shows the section of bed and guide adopted by a firm of Lancashire makers for their well-known Corliss engines, which it would be difficult to improve upon for first-class work.

(To be continued.)

Sugar-making Machinery.–XIV.

[ALL RIGHTS RESERVED.]

Extraction of the Juice.—The first step in the production of sugar from the cane is the extraction of the juice, which is contained in numerous cells surrounded by woody matter or fibre of more or less hardness. The liberation of this juice is effected in various ways. The method most generally employed is that of rupturing the cells by crushing; or by a combined crushing and soaking process, called maceration; or by the "diffusion" method.

We shall for the present confine our attention to the first-named method, that of rupturing the cells by pressure. This is effected by the use of

Roller Mills.—The principles of this method of extraction have hardly changed for centuries. The most elaborate and expensive mills of the present day are but modifications of the primitive mills of ages ago, when with much more labour and less economy a few armfuls of cane were crushed in rude and inexpensive wooden mills. The original form of mill is still in use in some parts of India, being an adaptation of the mortar and pestle of the apothecary. In the Benares and adjacent districts it has the mortar composed of stone, the basin which forms it being cut out of one end of a stone cylinder, which is set upright in the ground. This basin is cut into two chambers or divisions, one over the other; the upper being about a foot in diameter, and the same in depth, with sides sloping inwards from the rim; the lower division, which opens from the upper, is of a hollow spherical shape, and about 6in. in diameter. The pestle is made of hard wood, and of a shape to fit the mortar, being rounded into a ball at the lower end, to fit loosely into the lower chamber, while the stem works round the inner surface of the upper basin, and crushes the pieces of cane, which are 4in. to 6in. long, thrown under it by the attendant workman as it gyrates. The pestle handle is a pole 12ft. to 18ft. long, standing obliquely from the mortar, and from its summit is suspended, by a long bamboo hanging perpendicularly down, a horizontal pole or boom, one end of which works against the outside of the stone cylinder by means of a semi-circular wooden rest, in the same manner as the gaff of a ship. To the outward end of this boom, near to where it is suspended by the bamboo before described, are attached a yoke of oxen, which give the motive power to the machine by walking continually in a circuit round the mortar. A small hole from the base of the lower chamber conducts the juice out at one side of the cylinder, from whence it falls into an earthen pot placed to receive it. This mill is very similar to that used by the natives for extracting oil. In some districts the mill just described is made smaller, the mortar being formed out of a block of wood of jack or mangoe tree, the crushing power being increased by the weight of the bullock driver sitting on the end of the horizontal boom behind the cattle, and additional weight is also frequently given by piling blocks of stone or earth behind the seat of the driver.

The native horizontal mill is composed of two horizontal wooden rollers, placed one above the other in close contact, and supported by their axes being passed through corresponding holes in two upright posts fixed firmly in the ground. Each roller has one end of its axis projecting several inches beyond the perforation in the upright post, and to these ends are fixed two pieces of bamboo, about 3ft. long, in the form of a cross, which are used as handles or levers wherewith to turn the rollers by hand; one such cross being at each end of the mill, and so allowing two men to work it at once. The rollers are about 2½ft. long and 6in. in diameter, and the axes about half the size; the rollers are corrugated by being turned with grooves on them to facilitate the crushing of the cane between them.

With this mill four men are required to be in constant attendance on it—two to turn it as described and two more to feed the cane, one sitting at each side of the rollers. The first feeder takes four or five canes in his hands and passes them through the mill; they are then handed back over the mill by his fellow on the opposite side to the first, who passes them through again, and so on for four or five times, until the canes appear tolerably flat and dry. The first feeder then takes them collected in his right hand in a bundle, one end of which he introduces into the mill, and as the whole is drawn through he twists them round with his hands in such a way that the whole passes through in the form of a coarse rope. This is the final squeeze, and there is very little juice left in the cane after this operation. The process is tedious but very effectual.

A mill of more pretensions than this, used in parts of Eastern Bengal and elsewhere, is called the "Gandhi." It is composed of two large heavy vertical rollers, held together by heavy blocks of wood, built in the form of a door frame. The lower sill is firmly embedded in the earth, and has a hole in the centre into which is fitted a receptacle to catch the expressed juice. The upper ends of the rollers have strong teeth, cut out of the wood in a spiral so as not to fall across the grain. One of the rollers is longer than the other, and is fitted at the top with the shafts, which are drawn round slowly either by men or bullocks. The pressure is regulated by means of wedges, and can be made very considerable; but the friction set up is very great, and the creaking of the parts rubbing together can be heard a long distance off.

Various attempts have been made to improve such mills and still keep them comparatively cheap. One of the best known of these is Thomson and Milne's, which is illustrated in the views Fig. 29.

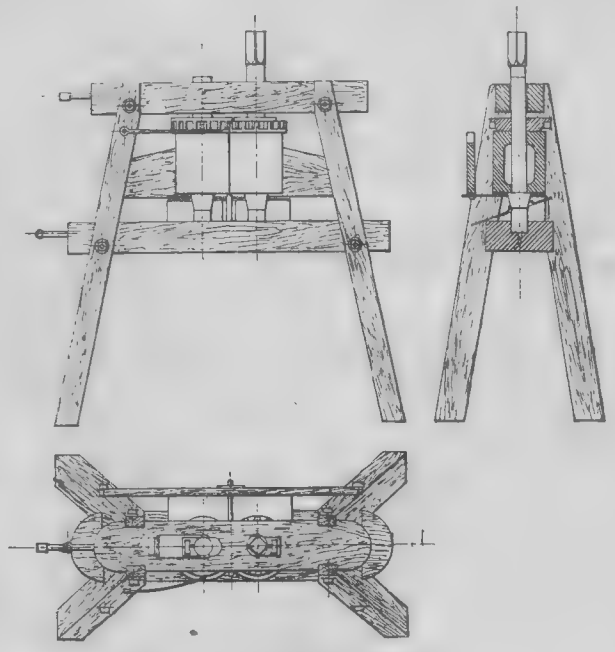
It consists of two vertical crushing rolls, with a flange to prevent the escape of cane upwards between them, and an adjustable bar that will allow expressed juice to fall down, but prevent escape of cane downward from between the rolls. The rollers are held in a frame having two longitudinal or cross pieces, firmly supported and kept in place by four standards or legs, of such length as to raise the rolls to a convenient height for feeding them with cane, and for applying the motive power. The lower ends of the legs are firmly embedded in the earth while at work.

The rolls are keyed on wrought-iron spindles, one of which latter is prolonged to carry the cattle pole or operating lever.

Each roll has a cast-iron pinion gearing into another, so as to cause them to revolve together. The ends of the spindles are carried by the two cross beams as shown. Beneath the rolls is a plate for guiding the juice into a suitable receptacle. In front of the rolls is a wooden board having a number of holes pierced in it, arranged vertically, through which the canes are fed into the rollers.

Table A gives the results of a test made with this type of mill at the Calcutta International Exhibition. This mill was much superior to any other shown.

In a trial with this type of mill and a native "Ghandi," the results given in Table B were obtained. The canes, however, had been long cut and exposed to rain.



SUGAR-MAKING MACHINERY.—FIG. 29.

The most general form of mill is, however, the three-roller type, made in a variety of forms, but mostly horizontal.

The ordinary three-roller sugar mill consists essentially of three cast-iron rollers arranged in pyramidal form, the line joining their centres forming nearly an

TABLE A.

Size of Mill.	Weight of Mill.	Power Used.	Cane Crushed.	Juice Extracted.	Megass.	Total of Juice and Megass	Loss of Weight	Time taken.	Juice.	Loss.	Capacity per Hour.	
											Crushing Cane.	Extracting Juice.
in.	lb. oz.		lb.	lb. oz.	lb. oz.	lb. oz.	oz.	M. S.	lb.	lb.	lb.	lb.
8×7	346 8	1 bullock	36	23 14	11 12	35 10	6	4 7¼	66·31	1·01	524	347

TABLE B.

—	Rollers.		Motive Power.	Men Feeding Mill.	Cane.	Juice Extracted.		Time.	Density of Juice. Beaumé.	Juice per Hundred.	Capacity per Hour.	
	Len.	Dia.									Cane.	Juice
	in.	in.			lb.	Sr.	Ch.	M. S.				
Native "Ghandi".....	51	8¼	6 men	2 men	100	48	8	22 30	7¾	48·8	534	259
Thomson and Milne's.	10	8	6 „	1 „	100	55	8	2 15	7	55·8	540	300

equilateral triangle. The rollers, or "cases," are fixed generally by hydraulic pressure, or, where powerful enough presses are not available, by shrinking on strong wrought-iron or mild-steel spindles or gudgeons. When these are forced on by hydraulic pressure, the force required is from 10 to 20 tons per inch in diameter of the hole in roller.

In the larger sizes—above 10in. rollers—the gudgeons run in gun-metal bearings carried in "cheeks" or headstocks fixed to strongly-made soleplates of deep box section, which also act as juice reservers.

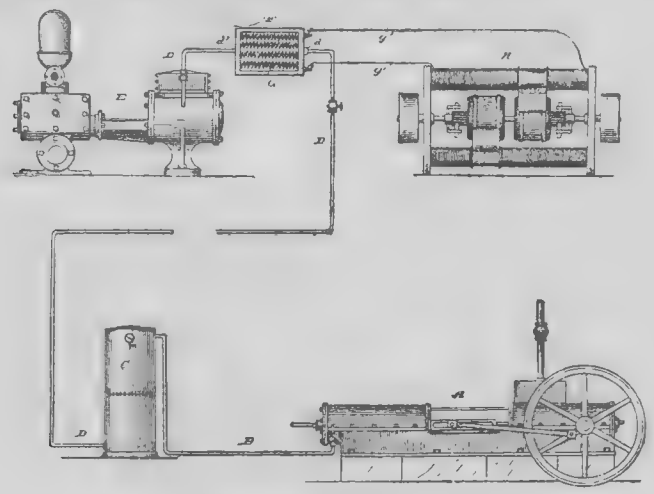
These mills are arranged in a variety of ways, according to the motive power applied.

(*To be continued.*)

A Practical Consideration of Compressed Air.

(*Continued from page* 270, *vol. xi.*)

FIG. 4 illustrates an electric reheater. The air compressor is shown at A, compressed air being conveyed through pipe B to



COMPRESSED AIR.—FIG. 4.

receiver C, thence through a conduit D to a pump E, situated, say, a mile away. In the engine room with the compressor is a dynamo H, which serves to light the mine.

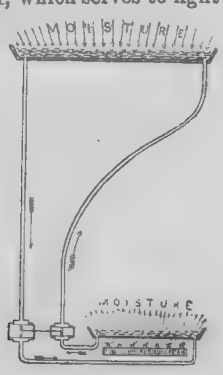


FIG. 5.

At a point near the pump a resistance coil F is placed in a chamber communicating directly with the compressed air. This resistance coil is made of any highly refractory substance, which resists the passage of a current to such an extent that the electricity is converted into heat, and the heat is thus imparted to the compressed air. Such a reheater as this has many advantages. The entire absence of combustion makes it perfectly safe for inflammable mines, and the ease with which it is applied by simply opening or closing a switch recommends it. It is also a cheap device, and has been applied recently in the shape of a simple coil of wire placed in an air pipe. The conversion of electricity into heat is an economical one, it being a well-known fact that a current of any potential, when intercepted by sufficient resistance, may be entirely absorbed and returned as heat. This is accomplished unit for unit, and as the loss in electric energy through transmission is low when compared with the shrinkage which takes place in compressed air, we here have a means by which the efficiency of the whole system may be increased by employing the electric wire to reheat the compressed air.

That it is theoretically possible to obtain from hot compressed air more power than was expended at the compressor, has been shown in Fig. 1. That this may not be confounded with perpetual motion, but may be made clear, I have prepared a sketch, shown in Fig. 5.

Sulphuric acid in its concentrated form will, when exposed in an open dish, absorb moisture from the atmosphere to the extent of about double its weight. A hypothetical assumption is made of a pump arranged to discharge sulphuric acid in the direction shown by the arrow to an open dish elevated, say, 100ft. The amount of power necessary to discharge a certain quantity of sulphuric acid into this dish is exactly equal to the power which the sulphuric acid is capable of giving out when falling back again, less the friction of the pump, leakage, etc. Now, let us assume that the sulphuric acid in the open dish remained there long enough to absorb moisture from the atmosphere until its weight has been doubled; it will thus obviously have twice the amount of power in falling back again, and if the friction and leakage losses were not too great, it will be capable of driving the pump, and of returning an equivalent volume of the concentrated acid to the dish. If the same acid is used over again, the moisture must be driven out, and lamps are shown in the sketch provided for this purpose. The analogy between this hypothetical case of sulphuric acid and one of compressed air is, that as with acid we may draw power from moisture which is contained in the air, so with compressed air we may draw upon the intrinsic heat energy of the atmosphere.

These thoughts suggest the advisability of defining still further what is meant by intrinsic energy. Air being a practically perfect gas it will expand or contract in volume through a definite range in proportion to its temperature. Experiments made with air at temperatures between the freezing and the boiling points of water, have given us the ratio of contraction of volume by reduction of temperature from which the absolute zero has been determined. The absolute zero of air is about – 461° F., and is that point at which any volume of air is reduced to nothing through expansion. In other words, the air may be said to be condensed at – 461°. We have, therefore, a base line which limits the power contained in any body of air.

Fig. 6 is a graphic diagram, drawn for the purpose of illustrating the fact that the power which is contained in any body of air at a given pressure is dependent upon its distance in temperature above the absolute zero, and that there is as much power in 1lb. of air at 15lb. gauge pressure and 60° temperature, as there is in 1lb. of air at 100lb. gauge pressure and 60° temperature. 1lb., or 13 cubic feet, of air at 15lb. pressure and 60° temperature, is represented by the space C. The available power in this air is 21,469ft.-lb. By available power is meant the amount of power which can be utilised when this air is expanded adiabatically to atmospheric pressure. The diagram shows that when such pressure is reached the temperature will be – 57° F. There still remains in this air a certain amount of intrinsic energy, and the diagram and figures show that this energy is equal to 74,134ft.-lb. This, added to the available energy, gives us 95,603ft.-lb. as the whole energy contained in 1lb. of air at 15lb. pressure and 60° temperature.

D represents 1lb. of air at 100lb. pressure and 60° temperature. Its available energy is 77,804ft.-lb., and its intrinsic energy is 17,799ft.-lb., or the total energy is 95,603ft.-lb., which is exactly equal to the case just cited.

These figures prove the correctness of that thermodynamic law which states that the power of any elastic gas is in direct proportion to its height of fall. So long as the temperature is above the absolute zero there is as much power in the same body of air when expanded adiabatically from a moderate temperature to an extremely low one as when expanded from a high temperature to a moderate one, and this offers to some extent a limitation to that system of reheating which increases the volume without at the same time increasing the pressure.

Fig. 7 is a diagram which illustrates a typical case in American practice, where air is admitted to a compressor at 60° and compressed adiabatically to 100lb. pressure. It is then transmitted a sufficient distance to cool it down to 60° temperature and expanded back to atmospheric pressure, the temperature falling to – 364°. The conditions shown in the diagram are extreme and purely theoretical. In actual practice both compression and expansion are only approximately adiabatic.

(*To be continued.*)

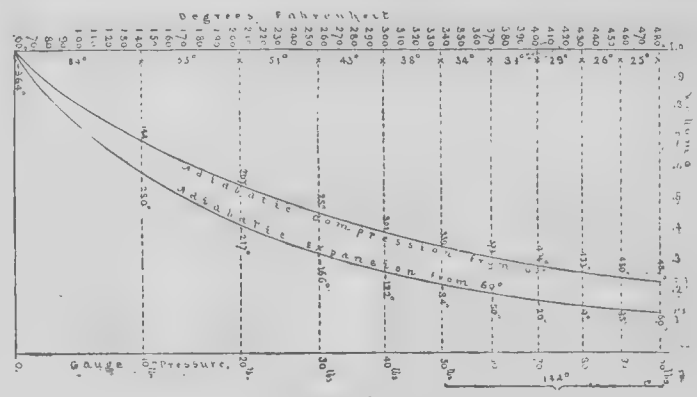


FIG. 7.

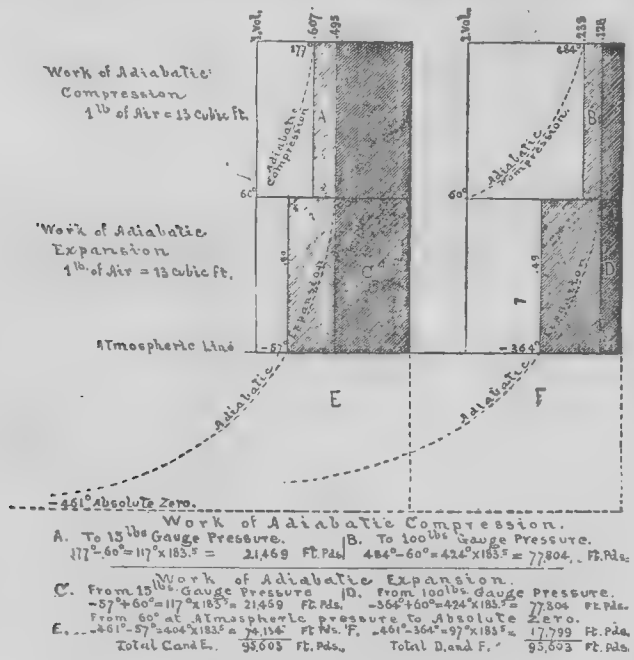


FIG. 6.

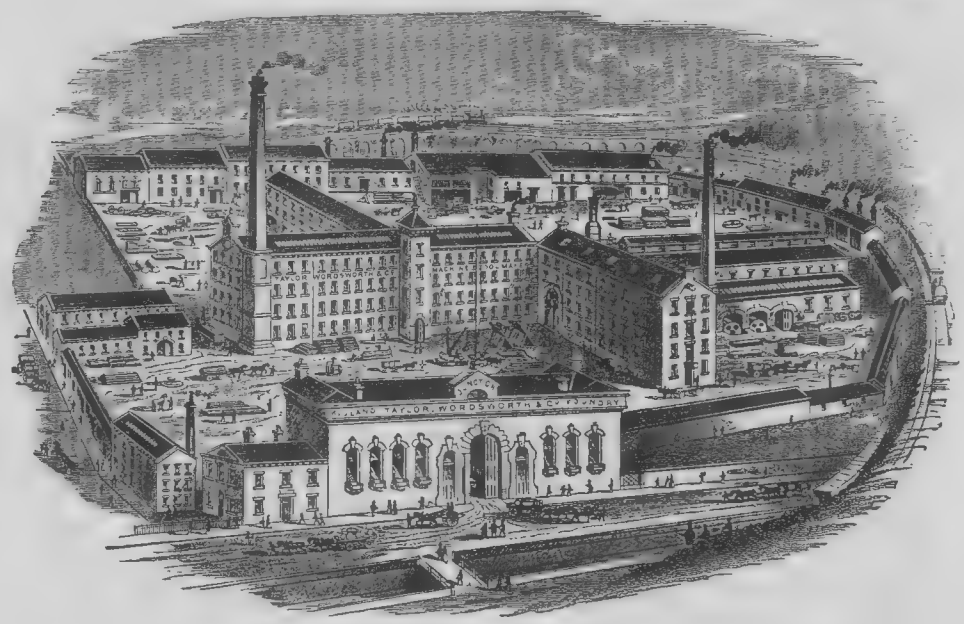
Famous Firms.

(*By Our Special Correspondent.*)

MESSRS. TAYLOR, WORDSWORTH AND CO., LEEDS.

LIKE many another of its class, this well-known firm of machine and tool makers has risen during the course of the present century from very small beginnings. The business was founded in the year 1806 by the two gentlemen whose names are still retained in the style of the firm. At first, and for a considerable number of years, special attention was paid to the making and improvement of flax machinery, and to Messrs. Taylor, Wordsworth and Co., in conjunction with the late Mr. Solomon Robinson, belongs the credit of being the earliest house to dress flax by machinery, and, in conjunction with the late Mr. Kay, to perfect the system of spinning flax by hot water—a process which enabled finer numbers to be spun from the same quality of flax than was possible by the old and effete process. The proprietors of the Midland Junction Foundry also took out numerous patents for improvements in dressing manilla and other hemps, and in this direction also they met with unqualified success, it having been proved to demonstration that by their improved system the hemp was more durable than by any other system then in vogue.

At a somewhat later date in their history, Messrs. Taylor, Wordsworth and Co. showed themselves to be pioneers in other departments of textile-machinery production. They claim that they were the first to develop all the systems of wool-combing machinery now in general use in England. Since bringing out these machines along with the three patentees—Messrs. Lister, Donisthorpe, and Rawson,—Messrs. Taylor,



WORKS OF MESSRS. TAYLOR, WORDSWORTH AND CO., LEEDS.

Wordsworth and Co. have made many great and important improvements, especially in Noble's combing machines, for successive inventions in which they have taken out many patents, and have thereby brought the machine to a rare degree of perfection. They are, in fact, one of the largest makers of these combing machines in the textile world, and it is estimated that there are at present running fully 4000 turned out by the firm. Messrs. Taylor, Wordsworth and Co. claim, further, that they were the first to put upon the market screw-gill machinery for preparing long wool and making it suitable for combing. In this direction, too, they have in the course of years effected considerable improvements. One of the most noteworthy of their patents was in screws, beginning with a single screw and finishing with double screws, so that the fallers are running at double speed when nearing the front roller. By this means shorter wool is straightened out in the preparing gill box before combing. The name of the firm is also associated with the gradual increase of faller screws to screw-gill machinery, and with the manufacture of machinery for all kinds of felt for cloths and carpets. They are also extensively engaged in making machinery for the carding, preparing, and spinning of woollen and worsted carpet yarns, stocking yarns, etc., etc. They have also been honourably associated with the success of the condenser for woollen cloth yarns. Prior to their adoption many attempts had been made to bring the condensers into general use, but no conspicuous success seems to have been made until Messrs. Taylor, Wordsworth and Co. took the matter in hand. Now all the old "billies" have gone the way of all obsolete machinery, and condensers reign supreme.

The present partners in the firm are Mr. Henry Walton Whitehead, son of the late Mr. John Whitehead, who worked for the founders, and who was taken into partnership soon after they commenced business; and two of the grandsons of the late Mr. John Whitehead—viz., Mr. Charles Whitehead and Mr. John H. Whitehead. Under their energetic management, we may remark, the firm has continued to grow. Their *clientèle* is a world-wide one; Messrs. Taylor, Wordsworth and Co.'s machinery is known and appreciated wherever woollen and worsted manufactures are carried on, and now when trade is good employment is found for over 500 hands.

The machinery made by the firm at the present time comprises wool-combing machinery, worsted-preparing spinning and twisting machinery, stocking-yarn and carpet machinery on the carding, without combing principle; fine wool combing machinery on the carding principle, preparing, backwashing machinery on their patent principle, and wool burring machinery for the above combing plants, when fine burry wool is required to be combed, which crushes the burr and leaves it all in the noil. They are also sole makers of Eastwood and Ambler's patent wool-washing machine, which is equally suitable for washing either the longest or the shortest wool grown.

With long wool backwashers and patent backwashers, long wool combing machines, preparers and gill boxes is a department in which they are at present very busy on account of the present fashion of worsted coatings and all kinds of Bradford goods running on the coarser quality of wools. In brief, Messrs. Taylor, Wordsworth and Co. are makers of all kinds of machinery for worsted, woollen, flax, tow, hemp, and all other fibrous substances except cotton. With Messrs. Eastwood and Ambler's wool-washer, to which allusion has been made, the makers claim that there is no felting of the wool, that the machine is self-acting without forks, that less soap is required, that the suds can be used over and over again, requiring less changing, that the bowls are easily cleaned, and that the wool is better washed. The machine consists mainly of two cast-iron bowls placed one above the other, with connections at both ends for the sud to pass from one to the other. The bottom bowl serves as a receptacle for the preparation of the sud before use, and as a dirt-settling tank. The upper bowl is only used for washing the wool. The sud, after being prepared, is forced by the centrifugal pump into the upper trough at the feed end of the machine, where it is distributed equally over the wool by a perforated discharge tank. The unwashed wool is fed in the usual way over a feed apron, and is carried forward to the delivery end by the current of liquid assisted by the possers. The sud from the distributing tank meets with and thoroughly saturates the wool immediately on entering the bowl. This wool is then carried forward along with the suds underneath a series of possers or shower boxes. Each posser is perforated with small holes, so that the suds rush upwards through the perforations 22 times per minute in each posser, and rush back again when the possers ascend, thus keeping a quantity of suds continually passing through the fibres of the wool. Immediately on leaving the last posser the wool is conveyed on to a perforated brass mouthpiece to the nip of the ordinary squeezing rollers, to be delivered in the usual way to a second machine. This brass mouthpiece allows the water, and along with it all sand, dirt, and other impurities washed out of the wool, to flow into a cast-iron apron fixed underneath the squeezing rollers, the latter also catching the volume of liquid discharged by the squeezing rollers. The apron being fixed to the framing in an inclined direction, the liquid flows into the low sud bowl, but before it can enter therein it is filtered through a finely-perforated brass gauze, which prevents the passage of any stray fibre and the mixing of it with the scum. The supply of sud being in excess of that actually used in washing, there always remains in the bottom trough a sufficient quantity of liquid to allow for settling purposes before a second usage, so that by this arrangement all dirt, sand, and foreign matter settles to the bottom of the sud bowls, and the scum or yolk rises to the surface, remaining there until the time for cleaning out, whilst the clean sud floats about mid-way in the depth of the liquor. It is at this level that the pump draws its supply of sud for subsequent usage. Thus the methods adopted in this machine differ considerably from other wool washers.

In the way of cloth-finishing machinery made by Messrs. Taylor, Wordsworth and Co., we may mention their raising gig, for raising nap on woollen, union, worsted, and other goods; double-cylinder brushing and steaming mill, arranged either with mortice gearing or an endless belt; improved steam oven and wagon system, by which 40 plates are put into the oven at the same time that it takes to place one in the ordinary oven; flat or open cloth-scouring machine for worsteds, serges, and used also by dyers for working off; washing and scouring machine; shearing machines of all classes, etc., etc; their simple screw-gill balling machine; their improved screw-gill cone roving frame, with patent screws and flyers, and made with any number of spindles; their woollen scribblers, their four-licker-in carding engine, their wool plucker or mixing willey, and so on.

We have already alluded to the Noble combing machine. The history of the development of this machine is of great interest. We first come across the name of James Noble in connection with wool-combing inventions in 1805; but, as Mr. Burnley observes in his "History of Wool and Wool Combing," it was some half-century afterwards that the particular machine was invented with which his name is especially associated—that in which what is known as the Noble principle was first brought into operation. The invention of 1805 was in respect of "a machine for discharging a wool comb or combs by separating the top from the noils and drawing what is commonly called a sliver or slivers from the comb or combs." In 1833 he took out a second patent in connection with the same subject, but no specification was enrolled. Next year he obtained protection for "certain improvements in combing wool." Two years later he patented further improvements. "In the centre of the machine was a rotary comb carrier or axle provided with arms, at whose extremities were fixed the combs, set in tables or frames. The ends of these bearers moved in eccentric guides or grooves, fixed to parallel plates or the sides of the machine. The feeding comb was made to advance gradually on a movable table towards the rotary comb carrier until the wool upon it became exhausted, when it was returned for another supply." In 1846 Noble was at Leicester patenting a method of combing a circular carrying comb with a circular working comb, and of retaining wool in the revolving combs by a plate or stop when being worked by combs. At about this time he became associated with the Mr. Donisthorpe referred to above, and in 1853 was taken out the patent for the machine which was henceforth to be known as the Noble machine, and which represented a creative effort of no ordinary importance. It has been asserted that the machine was not Noble's at all, but Donisthorpe's, and the author of "Wool and Wool Combing" says it is "generally understood" that had the last named not been precluded by the terms of his agreement with Mr. Lister from bringing forward any wool-combing improvement on his own account, his name would have been joined with, if not substituted for, that of Noble in the original patent. However that may be, the machine was there. In 1856 it became of real importance by the application of Tavernier, Donisthorpe, and Croft's feed apparatus, and (as Mr. Burnley is careful to add) by its admirable construction by Messrs. Taylor, Wordsworth and Co. Speaking of the improvements made by the firm during the past thirty-six years, the same authority says that they "have kept well abreast of contemporary inventive effort in all the operations connected with wool-combing on the Noble system, and hold sixteen separate patents for improvements." The earliest of these dates from 1874—76, and relates to the conducting of the noil from the small circles without the use of noil rollers, bearing the noil loftier and effecting a considerable saving. It was the invention of Mr. H. Whitehead. In 1878 Mr. C. Whitehead introduced a patent sheet conductor to prevent stoppages and piecings in the slivers. In 1882 Mr. J. H. Whitehead added a spring feed knife and sliver guide, for which are claimed the advantages of easy regulation, the same height being always kept in front, thus preventing any extra pressure on the wool when the knife is altered for different feeds. Another improvement is Lister's patent self-lubricating dabbing motion, which Messrs. Taylor, Wordsworth and Co. have adopted with much success. By its use the brushes can run up to a thousand dabs per minute if required, whilst at the same time the better dabbing of the wool into pins is assured. Among other improvements applied to the machine are Greenwood and Farrar's patent leather traversing motion, which imparts a continuous motion to the leathers, and patent extra rollers for preventing laps; and Ackroyd's comb cleaners; also J. H. Whitehead's patent brass feed boxes, Pickles and Whitehead's patent rack circle, and Firth and Robertshaw's patent leather arrangement. The firm of Taylor, Wordsworth and Co. are at the present time throwing out a number of machines and replacing them with new labour-saving tools specially adapted for producing work on the duplicate system.

(To be continued.)

Shipbuilding Notes.

The first tank steamer built in Norway was recently launched at Christiania. She is 208ft. 6in. long, is fitted with triple-expansion engines, and will carry about 900 tons.

There was launched on the 7th inst., from the shipbuilding yard of Messrs. A. McMillan and Son Limited, Dumbarton, a steel barque with a deadweight capacity of about 2100 tons.

Messrs. Caird and Co. Limited, Greenock, launched, on the 7th inst., a steamer built to the order of the P. and O. Company. The vessel is of 4250 tons measurement, 6000 tons deadweight, and 2000H.P.

Messrs. Russell and Co. launched from Kingston Yard. Port-Glasgow, on the 5th inst., a three-masted steel barque of 1400 tons register, to carry 2400 tons cargo. The dimensions are:—Length, 236ft.; breadth, 36ft.; depth 21ft. 9in.

Messrs. A. Roger and Co. launched on the 8th inst., from their shipbuilding yard, Port-Glasgow, a full-rigged ship, to the order of Mr. Hugh Hogarth, of Ardrossan. The vessel is of the following dimensions:—265ft. by 40ft. by 23ft.; net register, about 1750 tons, with a deadweight capacity of about 3100 tons.

Messrs. A. and J. Inglis launched on the 7th inst. a steel screw-steamer of 600 tons for the Dundalk and Newry Steam Packet Company, for their trade between Newry and Liverpool. The engines are of the triple-expansion type, and the vessel is fitted with the electric light and all the latest requirements for a first-class passenger channel steamer.

At Renfrew, on the 7th inst., the hopper dredger "Triton" was launched from the yard of Messrs. Wm. Simons and Co. for the Government of Ceylon. The vessel entered the water with steam up and ready to commence its trials. This dredger is intended to deepen the port of Colombo to 30ft. depth of water. Its hopper compartments have a capacity for over 500 tons of dredgings. Triple-expansion engines of 600I.H.P. and two steel boilers of 150lb. working pressure are provided.

The paddle-steamer "Elvira," built by Messrs Blackwood and Gordon, Port-Glasgow, made her official trial on the 1st inst. The dimensions are:—Length, 122ft.; breadth, 18ft. 6in.; depth, 8ft. 1in. The engines are of the diagonal two-cylinder compound surface-condensing type; diameter of cylinders, 20in. and 34in., by 36in. stroke; supplied by steam from a multitubular boiler having a working pressure of 110lb. On the measured mile a speed of about 12 knots was obtained.

The Design and Erection of Flour Mills on the Roller System.—XVI.

After the wheat is weighed it is passed to a magnetic separating machine. The duty of this machine is to remove any metallic substances that may be among the grain. So far we have made no separation in the cleaning process, but at this stage it is most important that there should be an effective separation of the wheat from all metallic substances. This separation is required for the grinding of all kinds of grain, no matter what kind of machines the grain has afterwards to pass through. Many flour mills on the stone system have been burnt down through a piece of iron, a nut, nail, or an iron washer passing with the wheat between the faces of the stone, sparks being produced and the flame sucked and drawn up into the exhaust trunks, with a disastrous result of an explosion. On the roller system, however, the danger from fire is confined to the wheat-cleaning department. Nearly all wheat-cleaning machines are driven at high speeds, say from 400 to 800 revolutions per minute; also all such machines

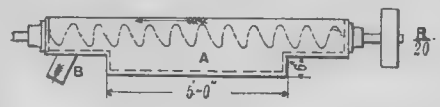


Fig. 17.

have a suction fan attached to them, drawing away the fine dust and delivering it to the stove rooms or dust-collecting chambers. It will be seen, therefore, that the difference between the stone and rollers is not very great so far as the fire risk is concerned; it is simply confined to the wheat-cleaning department, for it is quite possible to suppose a piece of iron causing sparks in a wheat-scouring machine as it would be with a pair of French stones. Assuming for the moment that iron is mixed with the wheat, the fire risk is about the same on the roller system as it is on the stone system, the only difference being that on the roller system the risk is removed to another part of the mill. But the reader must not lose sight of the fact that the risk of fire remains, and in order to minimise this risk, and also the damage caused by such hard substances passing through the machines, the magnetic separator ought *never* to be left out of a wheat-cleaning arrangement.

One of the earliest attempts to separate iron from wheat was by a worm and box with an extra deep bottom (Fig. 17). It will be seen that as the wheat is wormed to the delivery spout marked B, any substance that is heavier than the wheat will sink down into the deep part of the box marked A. It goes without saying that the worm must travel slowly (about 20 to 30 revolutions for an 8in. or 10in. dia. continuous worm), so as to give the heavy substances a chance of settling down at A. This collecting well is usually cleaned out once a month by sliding the bottom out, or in some cases the bottom is hinged, so that by removing a pin all the rubbish collected drops on to the floor or into a sack.

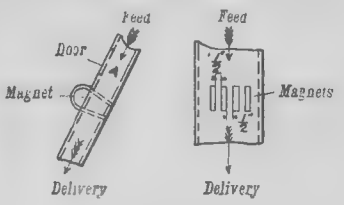


Fig. 18.

This separation by gravity gives good results, and there are plenty of flour mills that have no other arrangement to separate iron from the wheat. The writer was assured by an old miller of some 50 years' standing that he never found any iron, etc., in his wheats after travelling over a worm constructed as per sketch.

The next attempt to effect a thorough separation of iron from wheat was by placing four or five horseshoe magnets in a spout, the wheat passing through the magnets on its way to the delivery end, or to the next machine, just as the case might be. Fig. 18 shows how this arrangement was worked.

As the wheat falls by gravity down the spout marked A it passes through the spaces between the magnets, and consequently any pieces of iron that may be among the wheat is arrested at this point by the magnets. It is necessary to keep a watchful eye on this arrangement, or the spout will be choked by the rubbish adhering to the magnets.

For this kind of a magnetic separator to be of any service certain conditions must

be observed in the design and erection of the spout:—

(1.) The spout should not have a fall quicker than 45°, and should never be fixed vertically for this purpose. (2.) The wheat should travel on the bottom of the spout, and not all down one corner. (3.) There should be a double row of magnets, about 12in. to 18in. apart, so that there is no necessity to stop the feed when the top set of magnets must be taken out and cleaned. (4.) There should be a door about 18in. long in the spout just above the magnets. This door should not be fastened in any way, but left loose, so that if the magnets collect sufficient iron, etc., to choke the spout, the pressure of wheat will force this door off the spout and discharge on to the floor.

The slower the wheat passes between the magnets the more certain is the separation. The writer has seen good results obtained by the above arrangement in situations where an automatic magnetic system could not be obtained.

The introduction of a small and simple machine, called the magnetic separator,* has to a great extent displaced the old-fashioned methods of the worm and the series of magnets placed in a spout.

The magnetic separator receives the feed of wheat in a hopper; from this it passes over a metal plate the entire width of the machine, and as this metal plate is placed on poles of magnets, any metallic substance in passing with the grain over this plate is arrested and held until removed by a wiper. This wiper, being attached to an endless belt, passes about once a minute over the magnetic field, and carries off all metallic substances and delivers them in a box placed at the side of the machine.

This machine relieves the miller from a deal of care, and it is absolutely certain that no metallic substance can go with the grain to the next machine.

It is a very good plan to provide two magnetic machines for the wheat-cleaning department—viz, one for the dirty or uncleaned wheat, and another for all the cleaned wheat to pass through before passing to the roller mills, as it is quite possible for a lot of metallic substances to get into the cleaned wheat, such as nuts, bolts, washers, worm paddles, etc. All these items are likely to work loose on the various machines and travel on with the grain.

If roller mills are used, there is no danger in a piece of iron passing with the grain between the grooved rolls, but there is a lot of damage done; and as prevention is better than cure, a second magnetic machine for all cleaned wheat to pass through before going to the break rolls is a judicious investment, and soon pays for itself.

(*To be continued.*)

A Few Words to Engineers on Lubrication.†

THE question of lubrication has agitated the minds of mechanics for ages. Volumes have been written to cover the different phases, and to point out, according to varying individual views, the most effective and practicable plan of reducing friction and heat by lubrication. But, speaking in a general way, little has been accomplished as yet in the desired direction—for reasons which it is not necessary to deal with directly in this connection.

As is well understood, friction means loss of power, loss of fuel, loss of speed, loss of time, and not infrequently loss of life and property caused by fire from undue friction. Besides, there is the annoyance resulting from stoppages, and likewise a substantial item to go into the general calculation in the shape of cost for repairs.

But I will not dwell at length in this lecture on the subject of lubrication versus friction and heat, but will pass at once to a few of the general causes involved.

Taking, in the first place, the human or animal frame, we find there is not a joint, having either one or both parts moving in contact with each other, that has not a fluid or substance interposed between the two to obviate friction and facilitate motion. This fluid, whether oil or grease, plays the most important part in the life and operation of the joint. Should this lubrication cease, then the action of the joint would cease.

A more forcible illustration of proper lubrication for pressure, speed and durability cannot be obtained.

As to the causes of friction, I have, to my satisfaction, after many years of practice and extensive experiments, determined them to be two in number:—

1st. When a journal fits so closely into its bearings, or by its weight, that the contact is so close as to expel the lubricant from between the journal and bearings while in motion, it will assuredly cause friction, and this will be followed by heat. Heat will cause expansion of the metal, and the uneven expansion of parts will cause, accordingly, increase of heat; then comes the loss, as above stated.

Engineers and mechanics are well aware that two metallic surfaces can be so fitted that they will of themselves make an impenetrable and perfect joint. Knowing these facts, common sense teaches us that in a journal or joint where a motion is required, the journal should be so adjusted that it will revolve freely and yet without any perceptible play. This will allow the lubricant room to enter between both the journal and the bearing. The lubricant will then form a cushion, avoiding friction and ensuring safety and smooth running.

2nd. Friction and heat are also accounted for in journals and their bearings from the latter having too much play, as it is generally termed, and the shafting either being out of line or subjected to severe pressure; or by reason of belt strain causing concussion. The surfaces of both the journal and bearings receiving the full force of the shock will surely become heated if not destroyed. For example, hammering a piece of wire or metal will cause it to heat: try it and feel it.

Lubrication, if well understood, is the life of a machine. It is an impossibility to run without it, and if proper care and attention be given to good lubrication the highest efficiency and economy will prove to be the result. And in this connection it should be remembered that it is not the quantity of lubricant applied at one time that does the work, but it is the constant application, without waste, of a suitable lubricant that will give the best results.

In regard to waste, it is a positive fact that there are ten barrels of oil wasted where there is one properly used; for in most instances, where the oil can is used, the oil holes or openings on the journal boxes are generally filled until they run over; and it is not uncommon to see engines where the oil is dipped out of the frame under the crank and also from the fly-wheel pit, and the waste oil thrown on to the coal pile, where, on the other hand, if the proper cups and lubricant were employed, the waste and dirt would be entirely done away with.

In regard to materials used in the construction of journals and bearings, it is an admitted fact that both parts should not be of the same metal. Should both be made of the same material they would grip, as their affinities to each other would be in direct connection, and the surfaces of both soon be destroyed should no lubrication exist between them. Lubrication is nothing more than the introduction of a suitable body between one or two revolving or sliding parts of a machine, etc., for the sole purpose of forming a cushion between the two to reduce friction. This cushioning is the key to good lubrication.

For example, oil is a good lubricant and makes a good cushion where the journal or moving parts are not subjected to great weights or strains. But, on the other hand, should the journals or parts be of ponderous weight, and designed to perform work at intervals at each revolution of the journal or under heavy belt strains, then oil oftentimes proves to be too light to form a cushion, as shown by its displacement from between the two. Consequently the cushioning must be in accordance with the work, whether it involves oils, grease, or minerals.

Some writers claim that lubrication by oils is due to the molecular action and the small globules of oil, which keep the frictional surfaces apart, and form a cushion protecting to a certain degree the bearing surfaces from injury. No one will deny that oil as a lubricant will answer, and does answer, in most places where pressure, speed and friction are at a minimum, but as oils are easily displaced the cushioning materially decreases, and in many instances when the flow of oil ceases hot journals and bearings are the result.

Dry lubrication has also attracted the attention of many mechanics, and many costly experiments have been tried, with but little or no success; and up to the present time experiments and researches are still in progress to solve the problem of dry lubrication by the use of graphite, commonly called plumbago or black lead, which in its dry state is a good lubricant—provided it is free from grit. This grit question seems to be the most hurtful as to the article's qualities as a lubricant.

Graphite, plumbago or black lead, when mixed with oils or grease, loses its lubricating qualities, and is but little better than lamp black or soot mixed with oil or grease as a lubricant; and when applied in a dry state it accumulates on the journal and bearing, and becomes by friction ground up into a dead black powder that sticks to the journal and bearing, which would, if allowed to run any length of time, ruin both journal and bearing. After graphite has lost its lustre, either by being compounded with oil or grease or by pressure, its lubricating qualities are destroyed.

* An American patent.

† Lecture delivered by C. Verniaud, M.E., before the Lyceum of Stationary Engineers, Quincy, Ill.

Overhead Cranes Worked by Electricity.‡

THE author refers to the methods in ordinary use for working overhead cranes, and states that the use of electricity obviates much inconvenience, and the electrical apparatus can be easily applied to existing steam cranes. Messrs. Schneider and Co. have recently applied electricity for working a 60-ton overhead crane in their artillery workshops. The crane serves a shop 49ft. wide and 328ft. long. When driven by means of a cable it would only lift 35 tons continuously at a speed of 2ft. per minute, and with this load could only travel at a rate of 49ft. per minute. It was found that when the load exceeded 35 to 40 tons the cable slipped upon the guide pulleys, and was rapidly burned away; no cable lasted longer than from eight to ten months. Latterly it was proposed to use the crane over a length of 230ft. more, making a total of 558ft. This could not be effected by means of the cable, nor could the maximum power of the crane be used. Very satisfactory results were obtained upon a 15-ton crane by the adoption of a Ganz motor built at Creusot, and the same system was applied to the 60-ton crane.

The details are as follow:—A continuous-current Ganz motor developing 45,000 watts is fixed upon the framework of the crane on the opposite side to the controlling gear; this drives the shaft, upon which are fixed the gear wheels, by a belt of the same length as the width of the crane; the current is brought to the motor by two bare cables 0·47in. diameter fixed at the two ends of the shop, and carried upon porcelain pulleys 33ft. apart; the current is taken off by two brushes fixed upon the crane. All the accessory apparatus, such as switches, rheostats, ampèremeter, and voltmeter, are placed under the control of the driver. The current is produced by a dynamo of the same power as the motor, and the current is also used for a 15-ton crane and for a carpenter's shop in which machinery is driven by motors. With this arrangement the large crane easily lifts 40 tons at a speed of 7·2ft. per minute; it travels at a speed of 89ft. per minute, so that only six minutes are needed for travelling the whole length of the shop.

The electromotive force of the dynamos is constant at 220 volts, and the variation of speed of the motor between no load and full load does not exceed 5 per cent.; no special precaution is needed in raising the load suddenly; a special safety apparatus has been arranged. Messrs. Schneider are now designing a crane to lift 150 tons worked in the same manner.

‡ Inst. C.E.: Foreign Abstracts.

Catalogues, Price Lists, Etc.

Engineers, Tool Makers, Metal Merchants and others are invited to forward Catalogues, Pamphlets, Circulars, Price Lists, etc., for notice in this column.

MESSRS. CHARLES CHURCHILL AND CO. LIMITED, Cross-street, Finsbury, have issued an elegant catalogue of American machinery and tools for which they are the agents in this country. The high-class tools made by the Brainard Milling Machine Company are fully illustrated, as are also a great variety of lathes made by Barnes, Flather, Reed, etc. Milling tools, chucks, and fine tools of almost every conceivable description, are to be found illustrated in this very complete work. The printing and general get-up of the book leave nothing to be desired.

MESSRS. WOODHOUSE AND RAWSON UNITED LIMITED, Queen Victoria-street, London, have issued a price list of "Pelton" water wheels and motors, which contains some interesting particulars of this remarkably efficient motor, and also table of power, weight, and head of water suitable for the various sizes.

The GLYKOLINE LUBRICANT COMPANY LIMITED, Middlesbrough, have sent us a copy of their new "price list," which contains no prices, but gives particulars of the various kinds of lubricants supplied and the methods of application.

Trade Notes.

The Dover Harbour Board have accepted the tenders of Mr. John Jackson, of Victoria-street, Westminster, for upwards of £400,000 for the eastern arm of the new harbour at Dover.

Messrs. William Simons and Co., Renfrew, have received an order from the North British Railway Company for one of their improved powerful dredgers. It is to be employed on the Forth.

In addition to a sum of £180,000 for the improvement of the Canada, Huskisson, and adjoining docks, the Mersey Docks and Harbour Board have voted a further sum of £27,000 for improvements.

The General Electric Power and Traction Company Limited, London, have received instructions to light the new Hemsworth Colliery, near Halifax. The plant consists of a 300-light dynamo, and the necessary wiring and fittings.

Messrs. Siemens and Halske have obtained the concession for an electric street railway between Berlin and Charlottenburg. This gives them the right over the principal street in Berlin until June, 1895.

The directors of the Manchester, Sheffield, and Lincolnshire Railway recommend a dividend for the half-year just ended at the rate of ¾ per cent. per annum, carrying forward £2239. The dividend for the corresponding period was at the same rate, when £2218 was carried over.

The report of the London and Greenwich Railway Company for the past half-year shows an available balance of £12,208, out of which the directors recommend a dividend at the rate of £1 7s. 6d. per cent., tax free, leaving £362 to be carried forward.

Messrs. Bradley and Craven, of Westgate Common Foundry, Wakefield, have commenced the manufacture of briquette machinery for utilising small coal, coke, iron ore, etc. It is proposed to introduce machines embodying Messrs. Yeadon and Craven's recent improvements.

The North American Railway Company have placed orders with Mr. Sprague and with the Thomson-Houston Company each for one electric locomotive of not less than 70H P. The Baltimore and Ohio Railway Company have also resolved to equip the tunnel of the Baltimore Belt Railway with electric locomotives.

The Mexican Government has granted a concession to the representative of the Mexican National Construction Company for a line of railway from Guadalajara, on the Mexican Central Extension, to run south to Colima. According to the terms of the concession, the work is to be begun within four months from date, and to be completed within three years.

During the past six months sewing machines to the value of £335,611 have been shipped to foreign ports from Glasgow, as compared with £153,753 in the corresponding period of last year. The increased tariff on these articles in Sweden and Spain is stated to partly account for the increased output, makers being desirous to stock the markets before the new rates come into force.

Messrs. John Wild and Co., Oldham, are introducing a new process for forging and rolling steel balls for ball bearings, now being so largely adopted in connection with various descriptions of machine tools. By the new process they are practically hammered balls, and it is claimed that the process is a very great improvement upon existing methods of manufacture.

We understand that very satisfactory results are obtained by Little's Patent Coking-Conveyor Mechanical Stoker, introduced by the New Conveyor Company Limited about 18 months ago. In a recent test in London 13cwt. of coal was burned in three hours, water evaporated 12,200lb., ashes and clinker 1cwt. 10lb. The cost per 1000gals. of water evaporated was 10s. 3d.; the next best coking-stoker burned 13s. 5d. worth of coal per 1000gals. evaporated, while the cost by hand firing was 17s. 3d. per 1000gals.

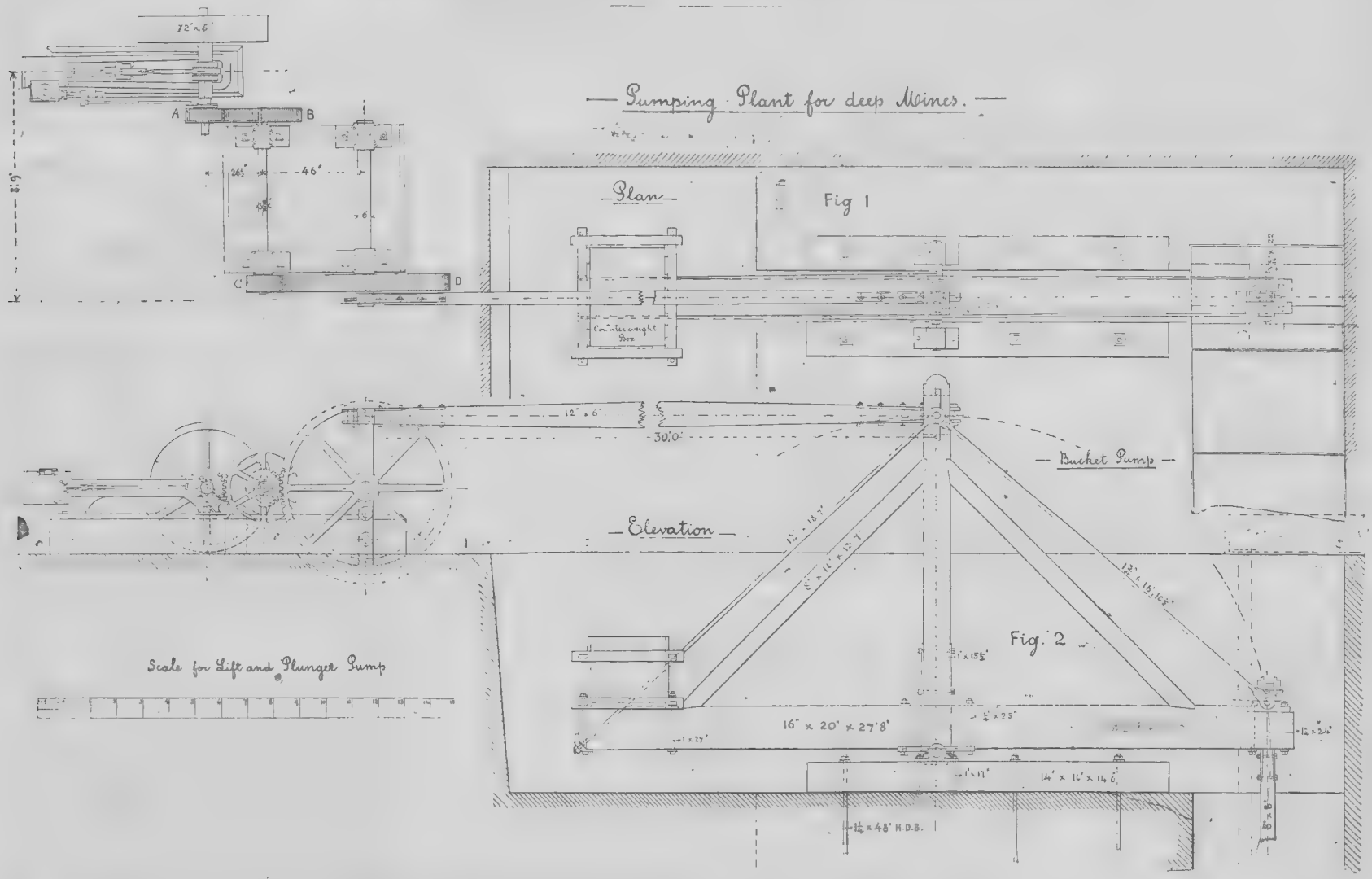
The directors of the Edison and Swan United Electric Light recommend a dividend on the A shares of 5s. 8¾d. per share on the ordinary shares (£3 paid), of 9s. 6½d. per share on the £5 fully-paid shares allotted to the Edison Electric Light Company Limited, and of 8s. 10¾d. per share on the £5 fully-paid shares allotted to the Swan United Electric Light Company Limited, being, with the interim dividend paid in February, 7 per cent. in respect of the year ended the 30th June, 1892, 7 per cent. in payment of arrears of cumulative preferential dividend for the year ended June 30, 1887, and of 4 per cent. in respect of the year ended June 30, 1888.

Wheel cutter in metal only. Every description of gearing. R. CHEDLAW, 43, City-road, Manchester.

The "Tool and Machinery Register" contains 4000 lots, new and second hand, for sale and wanted: 2d. post free. Britannia Company, Colchester, and 100, Houndsditch, London.

Having regard to the enormous circulation of THE MECHANICAL WORLD, the Editor suggests that it is by far the best medium for the insertion of every kind of "Wanted" advertisement, and the price is only one half-penny per word. The Editor will be glad if MECHANICAL WORLD readers will kindly bear this in mind as occasion arises.

MINING PUMPING ENGINES.

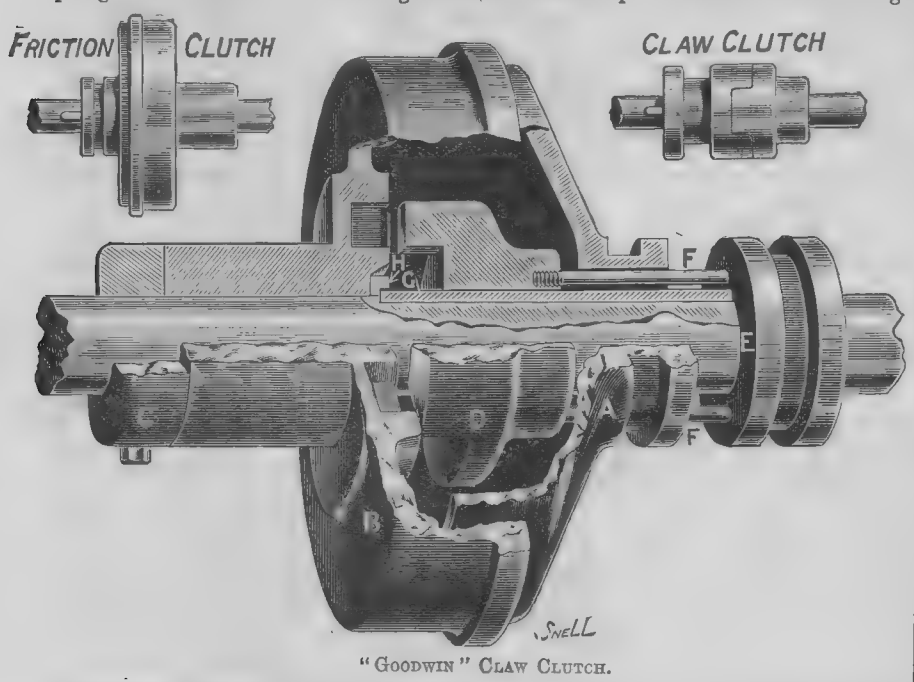


The "Goodwin" Claw Clutch.

THE greatest defect in the ordinary form of claw clutch is the impossibility of throwing the clutch into gear without shock, and it is doubtless owing to this drawback that the friction clutch has been so largely used in its place. The clutch illustrated herewith consists of a combination of the two, A being the inside or male part of the friction cone, B the outside or female part, which runs freely on the shaft between the retaining collars C and H, and on the projecting boss of which can be fixed gears or pulleys. D is a three-pronged claw clutch. E is a sliding collar connected to D by the two steel rods F F passing through clearing holes in A. G is a feather key fixed into the shaft upon which slide A, D, and E, causing these to revolve with the shaft.

To operate the clutch, the part A, which is driven by the shaft, is pressed by a lever into the part B, gradually raising the latter to the same speed as the shaft. When this speed is attained, the claw clutch D is pushed forward, and the claw is readily engaged. Should the recesses in B not come opposite the prongs on D—thus preventing engagement—a slight release of the frictional driving power allows the part B to slip slightly, thus bringing the recesses into the right position for the prongs to enter. The friction cone A is next released, whereupon the claw clutch transmits the full power of the shaft, and all strain upon the two striking levers is entirely removed.

We recently had the pleasure of inspecting one of these clutches in operation at the works of the makers, Messrs. Arnold Goodwin and Son, Sumner-street, Southwark, London, who have already supplied several as substitutes for friction clutches. Engagement is readily effected at reasonable speeds without shock, and there can be no question as to the positive nature of the driving.



"GOODWIN" CLAW CLUTCH.

As will be seen, the arrangement is simple and reliable, and as jar and shock are avoided, the durability of this clutch must be immeasurably superior to the old form of claw clutch.

THE copper statistics for June issued by Messrs. H. R. Merton and Co. show that the stocks of the metal in England and France increased during the month from 53,965 tons to 56,604 tons, whilst the deliveries rose from 8857 tons in May to 9260 tons. The total supplies amounted in June to 11,899 tons, which compares with 8994 tons during the previous month.

Mining Pumping Engines.

[CONTRIBUTED.]

THE following particulars of mine pumping engines will probably interest many readers.

Figs. 1 and 2 show the general arrangement of a Cornish pumping plant in common use for the unwatering of deep mines. This type of pump for draining mines has been found by long experience to be the simplest, safest, and most economical for the purpose, whether the arrangement be as shown—viz., the pump worked by a horizontal engine and gearing,—or by a bull or a beam engine.

In the example given the main parts consist of :—

1. The horizontal engine.
2. The gearing.
3. The sweep or connecting rod.
4. The pumping or tee bob.
5. The pitman, or main vertical connecting rod.
6. The pump rods or dry spears.
7. The bucket pump.
8. The suction and delivery pipes and clack pieces.

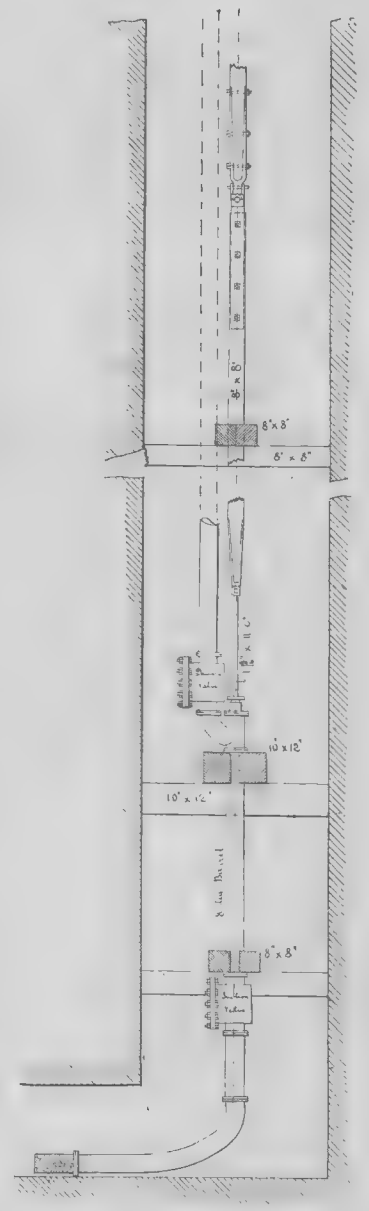
The following list of materials giving detailed sizes for such a pump will be found serviceable by those interested in this particular kind of plant, such as the mine owner, the mining engineer, the manufacturer, and the mining draughtsman.

ENGINE AND CONNECTIONS.

1 16in. diameter × 12in. stroke high-pressure horizontal engine, with fly-wheel 6ft. diameter × 5in. face, complete.
1 spur pinion 1ft. 5in. diameter×2in. p.×27 t. ×6in. face×3½in. bore (A).
1 spur wheel 3ft. diameter×2in. p.×57 t.×6in. face×3½in. bore (B).
1 gear shaft 3⅛in. diameter×7ft. long.
2 pedestals for ditto, with 1in. bolts.
2 sets of wrought-iron collars 3⅛in. bore.
1 spur pinion 1ft. 2in. diameter×2¾in. p.×16 t. ×8in. face×3½in. bore (C).
1 spur wheel 6ft. 6in. diameter×2¾in. p.×90 t. ×8in. face × 6in. bore (D).
(Wheel D has provision for three different strokes—viz., 24in., 48in., and 66in.)
1 crank pin for same 4in. diameter×5in. long in the bearing.
1 gear shaft 6in. diameter×6ft. 6in. long.
2 pedestals for ditto 6in. bore, with 1¼in. bolts.
2 sets of wrought-iron collars 6in. bore.
1 sweep rod (connecting rod) 30ft. centres, with 12in. × 6in. timber.
1 set of 2 skeleton straps 4ft. 6in. long × 4in. wide × 1¼in. thick, 1 pair of brasses 4in. bore, 1 key, and 1 gib for crank-pin wheel connection.
2 bolts for ditto 1in. diameter×9¼in. long.
2 bolts for ditto 1in. diameter×9¾in. long.
1 set of 2 skeleton straps 4ft. 6in. long × 4in. wide × 1¼in. thick, 1 pair of brasses 3⅞in. bore, 1 key, and 1 gib for king post connection.
2 bolts for ditto 1in. diameter × 8¼in. long.
2 bolts for ditto 1in. diameter × 8¾in. long.

PUMPING BOB IRONS:

1 trunnion plate 5in. diameter bearing pins.
2 bolts for ditto 1¼in. diameter × 25in. long.

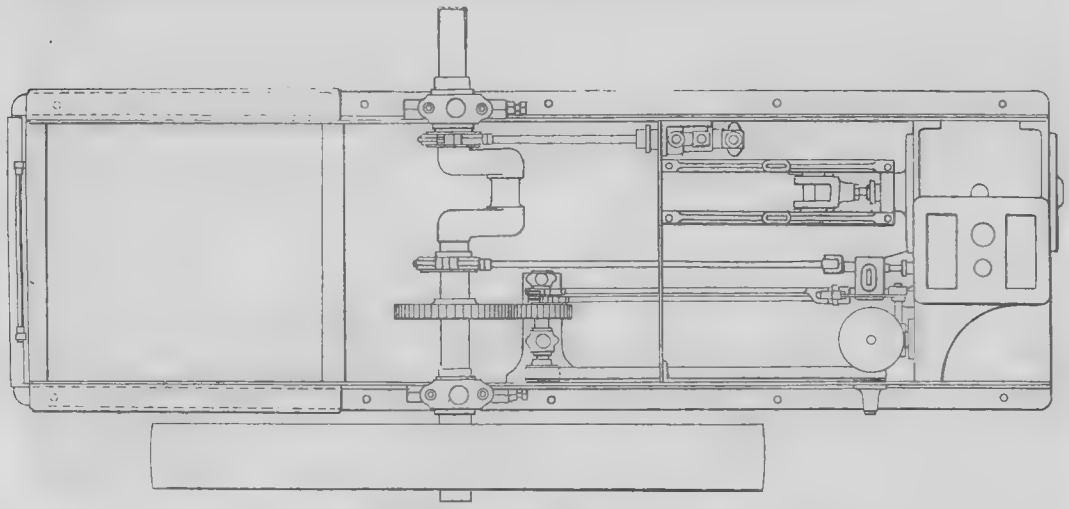


2 plain pedestals for trunnion bearings 5in. bore.
4 bolts for ditto 1in. diameter × 17in. long.
2 king post straps 4ft. 11in. long over all, 3¼in. long flat, 4in. wide × 1in. thick, and 25in. long round, 1¼in. diameter, end-screwed and nut.
2 bolts for ditto 1in. diameter ×15¼in. long.

2 top king post straps 7½in. wide, 1in. thick, 2ft. long.
4 bolts for ditto 1in. diameter × 18in. long.
1 king post pin 3 7/8in. diameter × 25in. long.
2 front bridle rods 1⅝in. diameter × 16ft. 10½in. long centres.
2 rear bridle rods 1⅝in. diameter × 19ft. long from centre to end.
1 tail washer for ditto.
2 nose bearings, cast iron, 3 7/8in. bore.
4 bolts for ditto 1¼in. diameter × 24in. long.
1 nose pin 3 7/8in. diameter × 22in. long.
4 bolts 1in. diameter × 27in. long, counterweight box.
6 foundation bolts 1¼in. diameter × 4ft. long, with cast-iron washers.

BOB TIMBERS.

2 pieces 14in. × 16in. × 14ft. long foundation frame.
1 piece 16in × 20in. × 27ft. 8in. long horizontal post.
1 piece 12in. × 16in. × 13ft. long king post.
2 pieces 8in. × 16in. × 13ft. 7in. long backs.
1 counterweight box, about 3ft. wide × 4ft. long × 2ft. 6in. deep inside, 1½in. thick sides, 2in. bottom, and framing.



UNDER-TYPE STATIONARY ENGINE.—FIG. 23.

8IN. JACK HEAD LIFT PUMP.

1 pitman rod 25ft. long centres, 8in. × 8in. timber.
1 set of 2 skeleton straps 4ft. 6in. long, 4in. wide × 1½in. thick, 1 pair of brasses 3 7/8in. bore, 1 key, and 1 gib for ditto.
2 bolts for ditto 1in. diameter × 8½in. long.
2 bolts for ditto 1in. diameter × 8⅝in. long.
1 lower pitman rod fork strap, 1½in. thick straps, 4in. wide, 4ft. 6in. long, 1 pair of brasses 2½in. bore, 1 rod end strap, 1 key, and 1 gib for ditto.
2 bolts for ditto 1in. diameter × 8½in. long.
2 bolts for ditto 1in. diameter × 9½in. long.
4 intermediate pump rods 8in. × 8in. timbers (length to suit depth of pit).
1 set of 2 upper pump rod skeleton straps 4ft. 6in. long, 5in. wide, 1¼in. thick, bored for 2½in. diameter pin.
1 pin for ditto 2½in. diameter × 10½in. long.
4 bolts for ditto 1in. diameter × 9½in. long.

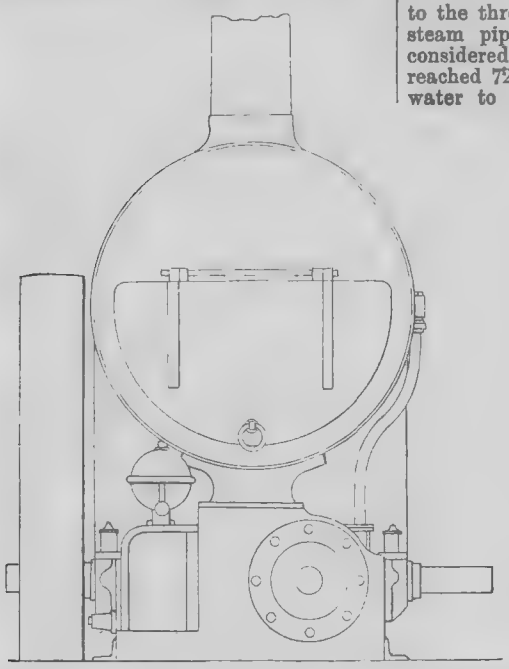


FIG 24.

3 sets (4 each) plain wrought-iron jointing straps with bolts for intermediate pump rods.
1 bucket rod fork 3ft. 3in. long, 1in. thick, 3½in. wide, with key, and bored to receive bucket rod.
1 bolt for ditto ⅞in. diameter × 7½in. long.
1 bolt for ditto ⅞in. diameter × 8in. long.
1 bolt for ditto ⅞in. diameter × 8½in. long.
1 bolt for ditto ⅞in. diameter × 9in. long.
1 bucket-rod 1 3/16in. diameter × 11ft. long, with key and pin.
2 buckets 8in. diameter (a spare bucket is always necessary).
1 stuffing box for bucket rod.
1 gland for ditto and bolts.
1 cast-iron jack head (bend, or goose neck).
2 door pieces, with doors.
32 bolts for ditto (16 bolts to each door), 1in. diameter × 5in. long.
4 clacks (or valves) to be fitted into door pieces (one spare clack to each always necessary).
1 working barrel 8in. bore, 7ft. long, 1in. metal, flanges 16in. diameter, 1¼in. thick.
1 length of 9in. bore suction pipe, ⅜in metal, flanges 15¾in. diameter, 1 1/16in. thick, about 2ft. long, and 1 spare length about 9ft.
1 length of 9in. bore suction hose, about 6ft. long.
1 strainer for ditto.
19 lengths of 8in. bore × 10ft. long delivery pipes, ⅜in. metal, flanges 14¾in. diameter, 1 1/16in. thick.
120 bolts ¾in. diameter × 3½in. long, for delivery pipes.
18 ditto ⅝in. diameter × 3½in. long, for suction pipes.
18 ditto 1in. diameter × 4in. long, for pump barrel.

(To be continued.)

Shaft Sinking at Rotherham Mines.

WE give herewith an illustration of the installation of Pulsometers used by Messrs. John Brown and Co. in sinking shafts at Rotherham Mines. The pumping was carried out under the supervision of Mr. Rhodes, the manager, and Mr. Green, the engineer, by the aid of nine of the Pulsometer Engineering Company's Pulsometer pumps. No workman from the makers was employed in working the pumps, nor did any of their representatives have anything to do with the arrangements, which were carried out by the gentlemen above mentioned. The three lower pumps were suspended by chains in three separate crabs placed a little way from the mouth of the shaft. The three bottom pumps were two No. 9's and one No. 10; the other six pumps were No. 9's. The steam was supplied to the three bottom pumps by a sliding steam pipe, as the use of hose was not considered desirable. The total lift reached 72yds. The greatest quantity of water to be dealt with was met at a depth of 50yds., where the quantity reached 130,000 to 140,000 gallons per hour.

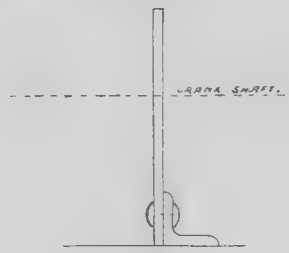


FIG. 25.

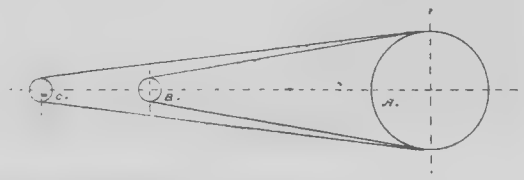


FIG. 26.

As the sinking proceeded a quantity of the water was tubbed back. The shaft was 18ft. diameter, and the space actually available for sinking, etc., was 12ft., although in the illustration, for the purpose of convenience, the pumps are shown as occupying 9ft. instead of 6ft. The pressure of steam in the boilers was 80lb. These boilers were situated 352ft. from the pit's mouth.

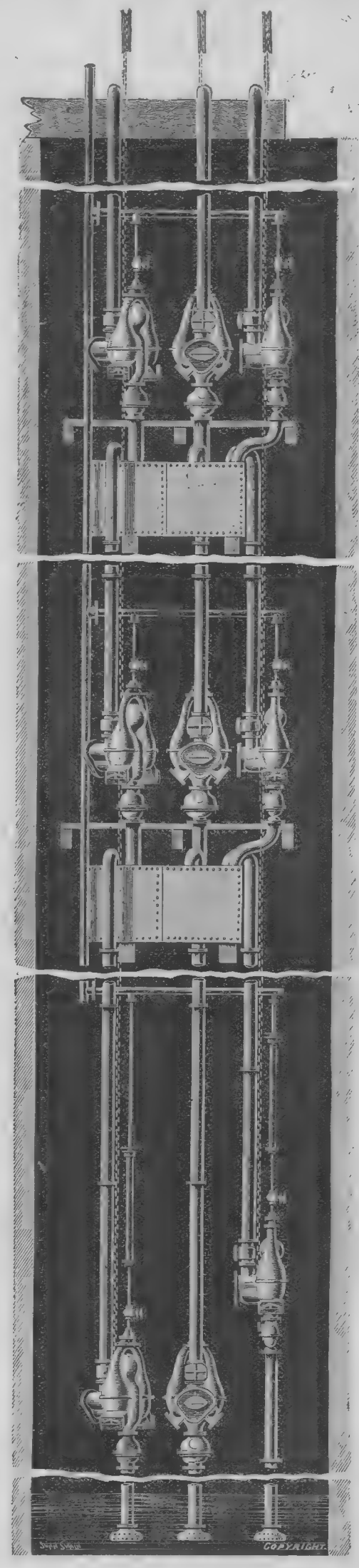
The foregoing affords a good illustration of the capabilities of the Pulsometer in sinking operations. At the same time it is only fair to say that much credit is also due to the users of the apparatus.

The Under-type Stationary Engine.—XVII.

IN this article we shall refer to a single-cylinder under-type engine manufactured by Messrs. Davey, Paxman and Co., of Colchester, which possesses some features worthy of notice, and, in addition, has proved itself to be very economical in fuel.

We may remark in passing that Mr. Paxman has never been backward in submitting any of his engines for trial and then allowing the results of the tests to be published in the technical papers. Several of such trials have already appeared, and in every case the Colchester engines have given a good account of themselves. It will be remembered that Mr. Paxman's engines carried off both the prizes offered by the Royal Agricultural Society at Newcastle in 1887.

It is to be regretted that scarcely any of



SHAFT SINKING AT ROTHERHAM MINES.

the engine makers apparently dare to follow Mr. Paxman's example, for we have few such tests carried out on the under-type engine by unbiassed experts. But to return to the subject of this article: Fig. 23 shows a plan of the engine with the boiler removed. Fig. 24 gives an elevation of the smokebox end of the engine. The unjacketed cylinder is 12in. in diameter and 14in. stroke. The engine is fitted with Paxman's patent valve gear, which consists of an ordinary slide valve with full travel and very little lap or lead, driven by an eccentric mounted on the crank shaft. The main valve works in a box close to a partition in the same plane in the steam chest. In this partition are made three ports, and over them slides a gridiron valve, acting as a cut-off valve, for no steam can get to the main or distributing valve without passing first through the ports in the partition. The cut-off valve is worked by an eccentric mounted on a counter shaft, shown in the plan. This small shaft makes two revolutions for one of the engine, motion being imparted to it by a pair of machine cut wheels. On the counter shaft a sheave is keyed beside the eccentric. This sheave is fitted with a hoop, and a rod from it extends to one end of a link, while the eccentric rod is secured to the other end of the link. A lever from a high-speed loaded governor is coupled to the link, and by this means the travel of the gridiron cut-off valve can be varied in a way which will be understood without further explanation. The cut-off takes place very quickly, the gridiron valve having a stroke of but half-an-inch. The engine drove the dynamos with remarkable regularity during the test, the hand of the tachometer fitted to the machine remaining at rest—a wonderful result with a single-cylinder engine.

It will be noticed from the end view (Fig. 24) that the engine is mounted on deep wrought-iron side plates, with a bar of angle iron riveted along the bottom of the plate. From the sketch (Fig. 25) it will be seen that the centre line of the engine is kept some distance below the top of the side plates, and so low down that the crank shaft carriages are let into the plates. The material is placed where it is most required—viz., along the centre line of the engine, and in a direct line with the engine strains. The side plates are 14in. deep; the cylinder is bolted to the plate on that side by means of two flanges cast on the barrel, as shown in plan. On the steam chest side a casting projects out to form a connection, the casting being of such a shape that the steam chest cover can be removed, the side plate being cut away to suit. The firebox of the boiler rests on a piece of angle iron riveted to the top of each girder, with suitable cross pieces so as to form a convenient ashpan.

The fly-wheel is 7ft. diameter and 9in. on face. During the test carried out the engine was made to drive two dynamos from a single fly-wheel; one belt had to run on the top of the other. Fig. 26 shows the arrangement: A is the fly-wheel, and B and C are the two dynamos. The pull of two double leather belts 8in. wide on to one fly-wheel put a great strain on the crank shaft, but there was no approach to heating of the bearings.

During the experiment carried out, and reported in a contemporary, the engine made 122 revolutions per minute, and the dynamos 650. The steam pressure was kept at 75lb. by a skilful fireman. About a dozen indicator diagrams were taken during the run. As the boiler pressure and the load were kept very steady, the cards were all alike. The average of several of them gave 43H.P., which is rather more than 3½ times the nominal horse-power—a fairly heavy load. The engine consumed 1cwt. of coal per hour while doing this duty, which is equivalent to 2·6lb per horse per hour. This is an admirable result, when we consider that this is an ordinary commercial engine, not made for racing. The cylinder is not steam jacketed, and the feed-water was not heated during the run.

The economy of the engine must therefore be due to the following among other causes: 1st, minimum clearance spaces; 2nd, a high initial pressure and a sharp cut-off, the expansion gear regulating the admission of steam into the cylinder exactly in proportion to the duty performed; 3rd, the small steam chests diminish the condensation of steam, the radiating surfaces being small; 4th, simplicity of construction, reducing the friction of the working parts; 5th, large boiler, supplying perfectly dry steam, no urging of the fire being required to keep up the pressure to the mark.

(To be continued.)

It is proposed to construct a railway between Kioto and Fushimi, in Japan, to connect with the Osaka Railway.

The Advance of Electricity.*

King Solomon, speaking of his age, said, "There is nothing new under the sun," and King Solomon was qualified to judge, for he was learned far beyond any other man of his time, and possibly beyond any who came after him. To the superficial student of scientific progress it may readily appear as if, in reality, there was nothing new under the sun. Let such student, however, once drink deeply at the fountain of scientific historical knowledge, and he will view the facts in a very different light. To assert that there is nothing new under the sun since the time of Solomon, is to assert that the human mind has made no progress since that time—has undergone no development. Certainly no one could be found willing to make such a monstrous assertion.

Ideas born out of time, like immature or unripe fruit, die an untimely death. Great ideas are conceived in different parts of the world by different brains at times often hundreds of years apart; but unless the world is ready to receive them they are unnoticed, perhaps ridiculed. Great ideas or inventions can be arranged under three great types of classes: Immature or incomplete, mature but unripe, ripe.

Ideas or inventions of the first type produce but little effect in the world—at times, however, they tend to direct thought to certain channels and thus act as forerunners of greater and more valuable ideas.

Ideas of the second type are mature, but the times are unripe for them; the condition of the environment unsuited; and, therefore, though matured and complete in themselves, like unripe fruit, they produce no progeny for the development of the world.

Ideas or inventions of the third type are of far greater value to the world than those of the second type, since they bear fruit almost immediately. It matters little to the world whether they have been conceived before or not. When practicable, they must necessarily find birth or creation as soon as the times are ripe for them. The fact that such ideas are subsequently found to be old ones does not prevent them from being original with their later producers. As to this class of inventions, if the world is ripe and ready to receive them, it may happen that they may be made in different parts of the world at about the same time. Prof. Youmans expresses it as his opinion that great ideas belong to eras rather than to individuals; that intellectual progress may move in waves toward the boundaries of the unknown, and many investigators moving with that wave may, at very nearly the same time, discover new features and facts on the horizon beyond.

Let us, then, with the scientific historian, pass hurriedly over the path of the wave of electrical progress, and note the more important records left by it at different stages of its advance. Beginning with the oft-reverted-to experiment of the Greek Thales, it was not much, when viewed in the light of the world at its birth, some 600 B.C., merely a piece of amber rubbed against the clothing; merely the gaining of a strange property of first attracting and then repelling light objects brought near it. It was, however, the birth of a great idea that, unfortunately for the world's progress, belonged to the class of immature ideas. Viewed in the light of to-day, its importance can hardly be over-estimated. It pointed out a *terra incognita*, an unknown realm of phenomena, that occupied nearly the entire domain of Nature, and only waited patiently to be observed. However, it bore no fruit until a thousand years later.

Too often is the cry of *cui bono* raised when some apparently trifling physical phenomenon is recorded; and I have no doubt that the friends of Thales regarded him in the light of a harmless enthusiast.

The next step forward was not made until toward the close of the sixteenth century, when Dr. Gilbert, physician to Queen Elizabeth, extended the observation of Theophrastus (the latter made in 300 B.C.), and showed that many bodies beside amber and tourmaline, when subjected to friction, acquired the strange property of attracting and repelling light bodies brought near them. He divided bodies into two great classes: Electrics, or those which could be electrified by friction; and non-electrics, or those which could not be so electrified. But we have since discovered that this classification was based upon an erroneous idea.

After Gilbert came Stephen Gray, who, in 1729, first pointed out the distinction between conductors and non-conductors of electricity; and Dr. Franklin, in 1748, set fire to spirits of wine by a current of electricity sent across the Schuylkill River, using the river and earth as return. It would seem that the telegraph belonged to inventions of the immature class, and at this time died without bearing fruit.

1745 was a memorable year in the history of electrical progress, for it was in this year that Von Kleist, Dean of the Cathedral of Comin, in Pomerania, made the discovery of the Leyden jar. This invention belonged to the type of ripe inventions, and naturally enough we find several claimants for its first conception. As far as I have been able to trace original records, it would appear that its first discovery was made by Von Kleist, in 1745, although Muschenbroek or Cunæus, of Leyden, also claimed the discovery.

Perhaps some of the most important investigations that have been made in recent years have been those of Nikola Tesla, concerning the effects produced by discharges of alternating currents of high potential at extraordinary frequencies.

Tesla has shown by a series of experiments that are unique both for their completeness and wide scope, that for discharges of enormous frequency ordinary conductors become absolutely non-conductors, while such substances as vulcanite and glass, that for ordinary currents possess the highest powers of insulation, are readily traversed by such discharges. He has proved that the physiological effects of such discharges are much less marked than are those of constant currents or of alternating currents of but moderate frequency. He has made many other valuable discoveries; indeed, the investigations made by this acute observer have almost opened, so to speak, a new science within the comparatively new science of electricity.

An exceedingly important discovery concerning a peculiarity of the discharge of the Leyden jar was made in 1842 by Prof. Joseph Henry, of America. This discovery refers to the peculiarity concerning the nature of the disruptive discharge of such jar; and it is on the line of this peculiarity that most of the recent developments of this instrument have been made.

The idea concerning the flow of electricity through a wire is apparently an exceedingly simple one. Up to a very recent date it was believed that electricity passed through the substance of the conductor. However, our modern views have changed profoundly in this respect. According to Poynting and others, the energy of electric discharges is not propagated or transmitted through the conductor, but through the ether which fills the interatomic or intermolecular spaces or the medium lying outside of the conductor as well as within the conductor itself. It is this medium which is known in science as the dielectric, and is ordinarily looked upon as the non-conductor or the insulator of the wire. For example, in the case of a telegraph wire strung on insulators and passing through the air between the two stations, the air and the glass insulate the said conductor from the earth. According to the modern theory of the propagation of electricity, however, the electric energy is in reality transmitted through such non-conducting paths, and is rained down on the surface of the conductor from the space outside it, the conductor acting merely as a sink or place where the electric energy can dissipate itself. The electric energy is, therefore, really propagated through the so-called non-conductor, and expends its energy or manifests its characteristic effects in the conductor itself.

As we all know, ships at sea are very liable to be injured by lightning, and until William Harris, of England, proposed a system for the electrical preservation of vessels, many good ships were destroyed by such discharges. Harris's proposition to place lightning rods on ships, like many propositions for the good of mankind in general, were first received with great disfavour by the public. Prior to Harris's time some little attempt had been made to protect ships from lightning, but ineffectually. The rods were passed along the masts of the vessel, often but a single rod on the main mast, which was carefully separated from any mass of metal in the ship and passed down into the water from the end of the bowsprit. Such a lightning rod, like an incompetent physician or lawyer, was worse than useless—indeed, dangerous; and considerable discredit was thrown on the protective power of lightning rods for such reason. Harris suggested the necessity of connecting the lightning rods with the copper sheathing of the ship's bottom, and with all masses of metal in the ship, and especially with the metal covering of the outside of the powder magazine. He was regarded as an innovator of the most dangerous type; but his invention was applied and proved most successful. As a result he was given the honour of knighthood.

It was not until the great and only Faraday conducted that magnificent line of experiments between 1831 and 1832 on the means for producing electricity from magnetism that the road was opened up for the production of a new electric source in a dynamo-electric machine. Nor was it until Sorens Hjorth and Gramme, together with numerous others, produced the modern dynamo that a ripe invention was offered to the world. The successful production of the modern type of dynamo machine probably found its first exponent in the completed Gramme machine. This machine gave that impetus to electric science which, beginning about 1874-75, has continued to the present day, and furnishes one of the best examples of remarkable progress along a particular line of science that the world has ever seen. To attempt to trace the history of the dynamo-electric machine would carry this paper to undue length. Faraday built far better than he knew. Could he see the many forms of dynamos which are in all parts of the world now converting mechanical energy into electrical energy, with wonderful efficiency, he would thus appreciate the almost immeasurable gift that he freely gave to the world.

The invention of the modern dynamo made possible the invention of the electric motor, which during the past few years has been successfully carried to an extent that appears almost incredible. Electric motors of efficiency as high, or even higher, than 90 and 95 per cent. can be produced. Contrast this with the efficiency of the modern triple-expansion steam engine. I believe in that case 17 per cent. would be regarded as higher than the facts usually warrant.

Let us not overlook the telephone.

An outgrowth of the telephone appeared in the phonograph, the invention of Edison. This instrument is familiar to all.

There are many other inventions which lack of time compels me to pass unnoticed. I know how dangerous it is, even under the most favourable circumstances, to assume the position of a prophet; yet I desire to venture a few suggestions concerning what seems to me electric science has in store for the human race in the near future:—

1. A cheaper means for the production of electricity than is now obtainable by burning coal for the purpose of driving a steam engine, which in its part turns a dynamo-electric machine. This invention will probably be found in some improvement in thermo-electricity, whereby coal will be burned directly to produce electricity, and not through the double intervention of the steam engine and the dynamo.

2. The entire replacement of the steam engine by the electric motor. I do not think it unreasonable to believe that many in my audience to-night will live to see the steam engine relegated to the scrap pile as antiquated, and possibly even to hear it spoken of in their times as an indescribable instance how an otherwise bright age should remain satisfied for so long with such a clumsy contrivance for the conversion of energy.

3. The successful solution of the problem of aërial navigation, effected possibly by means of the electric motor, resulting from the improvements in the production of electricity. In my own mind this problem needs for its successful solution only a means for obtaining great power with small weight.

4. The replacing of the electric light—that is, the present electric light, with its preponderance of useless and injurious heat energy—by some means of electrically-produced light, which shall possess a smaller proportion of the useless heat rays and a larger proportion of light rays. Though this discovery may come by the discovery of some means of producing cold light by chemical phosphorescence, yet it would seem more probable that it would be by means of physical phosphorescence or by means of molecular bombardment, as pointed out by Nikola Tesla in his classic experiments on the effects produced by alternating currents of extraordinarily high frequency and difference of potential.

5. A more intelligent means than is now adopted in the therapeutical applications of electricity to the curing of diseases, whereby human life may be considerably prolonged and human suffering lessened.

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* Abstract of a lecture delivered by Prof. Edwin J. Houston, of Philadelphia, before the Department of Electricity of the Brooklyn Institute of Arts and Sciences, Brooklyn, N.Y.

Mr. John Morton, general manager and secretary of the Glasgow and South-Western Railway, died on the 9th inst. He was taken ill in London some weeks ago while promoting a bill for his company. The deceased, who was formerly secretary only, had been many years in the company's service.

Metal Trade Memoranda.

Last month not a ton of Spanish ore was imported into Teeside. In ordinary times 100,000 tons are landed monthly.

The output of ore from the Arizona Copper Company's mines during the month of June was 157 tons of black copper, and 42 tons of matte. This is equivalent to about 186 tons of black copper.

The New Zealand Government offer a bonus of £1 per ton on the production of the first 500 tons of pig iron of marketable quality manufactured in the colony from material produced in New Zealand.

At a meeting of the Glasgow Goldsmiths' Company it was stated that 12,474oz. of silver plate, spoons, etc., and 982oz. of gold rings had been manufactured in the city and Hall-marked during the year.

The production of platinum in Russia in 1891 amounted to 258 poods 25lb. of crude platinum, being 85 poods more than in 1890. The total value of the output of the Russian platinum industry in 1891 was 1,250,000 roubles.

It is stated that there are 28 tinplate manufactories in the United States, and that more are being built, but notwithstanding this fact and the operations of the M'Kinley tariff the shipments of tinplates from this country show a large increase.

The Sardinian mining industry continues to prosper, especially in the province of Cagliari, notwithstanding the competition of America and Spain. There were in active operation during the year 1890-1, 84 mines, of which 75 were lead, zinc, and silver mines, 1 of manganese, 2 of antimony, 1 of iron, and 4 of lignite and anthracite. The total output of ore for the year was 165,256 tons, the value of which amounted to £827,982.

The Cleveland Ironmasters' returns for June show a reduction in stocks of 39,491 tons, leaving the whole stock of Cleveland iron 48,000 tons, 40,000 tons of this being warrants. The reduction since the Durham strike commenced is 238,000 tons. 57,000 tons of pig iron were produced in June. There are 76 furnaces in blast, as against a production of 6000 tons and 3 furnaces going in May, when the strike was on. The production is not much more than a fourth of what it was before the strike.

The official figures relating to the export of cutlery from Sheffield to the United States during the past quarter show an improvement upon the previous quarters since the passing of the M'Kinley Act, which threatened to put an end to the Sheffield cutlery trade with America. The value for the past three months was £33,090, against £21,000 in the corresponding period of 1891. Despite this recovery, the volume of trade done is still 40 per cent. less than before the passing of the M'Kinley tariff.

The report of the Rhymney Iron Company Limited shows that the amount carried forward from last year was £22,668. The profit on the year's working was £31,500, less loss on stocks realised, £8756, and deducting interest on debentures and prepaid capital, £16,685, leaving a balance of undivided profit of £28,727. An interim dividend was paid in February at the rate of 1 per cent. per annum, absorbing £4452, and it was hoped that a smilar dividend might have been paid at the present time; but, having regard to the unfavourable prospects of the coal trade and the further outlay necessary for the completion and development of the company's new pits, the directors do not feel justified in recommending a further distribution of profits on this occasion.

The Metal Market.

PRICES CURRENT.

LONDON, July 11.

LONDON, July 11.—Copper opened quietly at a loss of 3s. 9d., due to lower American advices, and, with an absence of demand from consumers and a less confident feeling, values further lost 2s. 6d. Some improvement, however, occurred after the official figures were posted on covering operations, and the close is steady, although still 5s. lower than Friday's official return. Three months moved at £45 3s. 9d. to £45 1s. 3d., cash at £44 12s. 6d., and July dates at £44 15s. to £44 13s. 9d. Sales, 600 tons. Settlement price, £44 10s. English tough, £48. Best selected, £48 10s. Strong sheets, £56 15s. to £57.

TIN began easy and 5s. lower, and developed decided weakness on reports from New York of the abolition of the duty on pig iron, this being accentuated later on by an anxiety to realise, and the close is weak with cash about 35s. down from Friday's official prices, while three months marks a fall of 22s. 6d. Late September sold at £96 17s. 6d., three months at £96 7s. 6d. to £96 5s., and prompt cash at £97; but after the official close cash in two days passed at £96 5s. Sales, 100 tons. Settlement price, £96 15s. English ingots, £99 to £100.

PIG IRON ruled dull, with the tendency somewhat in buyers' favour, and Scotch finished ½d. lower, but otherwise prices showed no variation. Settlement prices:—Scotch, 41s. 4d.; Middlesbrough, 40s.; hematite, 49s. 6d.

TINPLATES quiet. I.C. coke, f.o.b. London, 13s.; Liverpool, 12s. 6d.; Swansea, 12s. 3d. per box.

LEAD is firm at Friday's currencies. Spanish, £10 11s. 3d, sellers, £10 10s. buyers; English, £10 15s. to £10 17s. 6d.

SPELTER remains quiet and unchanged. July, nearest price, £21 12s. 6d. Silesian specials, £22.

ZINC.—Silesian sheets meet with some inquiry at £24 5s., ex ship. Belgian quiet. V.M. brands, £24 12s. 6d., ex ship; £24 7s. 6d. export sellers.

OFFICIAL CLOSING QUOTATIONS.

	£	s.	d.	£	s.	d.
COPPER—						
G. M. B.—Cash	44	11	3	44	18	9
,, Three months	45	1	3	45	8	9
English tough		—			—	
Best selected		—			—	
Strong sheets		—			—	
TIN—						
Fine foreign, cash	96	15	0	97	5	0
,, Three months	96	0	0	96	10	0
Australian, cash	96	15	0	97	5	0
PIG IRON—				s.	d.	
Scotch warrants—Cash				41	4½	
,, One month				41	7	
Middlesbrough—Cash				40	0	
,, One month					—	
Hematite—Cash				49	6	
,, One month					—	

GLASGOW, July 11.—Business has begun badly on the pig-iron market. Only Scotch warrants were dealt in, and that to the extent of only 2000 tons, but the cash price was practically unchanged from that of Friday. Cleveland and hematite were quite neglected, and at the last unaltered in value. The elections still interfere with operations, but a better inquiry forward is reported for some sorts of material to-day. The shipments of Scotch for last week were 7726 tons, an increase of 652 tons on the corresponding week of last year, and making the increase for year to date 34,463 tons.

QUOTATIONS.

	Highest.		Lowest.	
	s.	d.	s.	d.
Scotch warrants—Cash	41	6	41	5½
,, One month	41	7	41	6
Middlesbrough—Cash	40	0	40	0
,, One month	—		—	
Hematite—Cash	49	6	49	1
,, One month	—		—	

BIRMINGHAM, July 11.—The past half-year has been an unsatisfactory one for most of our local manufacturers, the demand being much under the average and prices depressed. Stocks, however, are known to be low in foreign and colonial markets, and the belief is general that when the elections and the holidays are over there will be a decided improvement in the shipping department. The local Vice-Consul's return for the last quarter, however, shows that our exports to the United States have again increased last quarter. With Chili, the Argentine Republic, and the Spanish West Indies business has been fairly brisk of late; but with the latter market there will now be a lull, owing to the new preferential treaty with the United States. Metal rollers and tube and wire drawers generally report business dull. It is only in high-class copper wire and thin sheets for cartridges that there is any activity. Brazed tubes are in limited request. Constructive engineers are mostly well employed. The perambulator branch is now rather quiet, and the same remark will apply to the cycle trade.

Trade Marks.

The following is the Official List of Applications published from June 29 to July 6, for the Registration of Trade Marks, so far as relates to the Metal Trades.

CLASS 5.

Magpie.

162,527. Sheet iron, galvanised and black, plain or corrugated. THE WOLVERHAMPTON CORRUGATED IRON COMPANY, Shrubbery Works, Wolverhampton, Staffordshire; iron and steel manufacturers and galvanisers.—8th February, 1892.

CLASS 18.

"The essential particular of the Trade Mark is the device, and the applicants disclaim any right to the exclusive use of the letters 'C C.'"

164,274. Electrical engineering contrivances included in Class 18. MAVOR AND COULSON, 56, George-square, Glasgow; electrical engineers.—19th April, 1892.

The Official Gazette.

Partnerships Dissolved.

JAMESON and SCHAEFFER, Newcastle-upon-Tyne, consulting engineers.

W. MAIR and J. B. LIPTROT, under the style of J. Greenall, Manchester, machine makers.

O. M. ROW and J. B. BREW, under the style of O. M. Row and Co., Liverpool, makers of fresh water condensers and hot water engineers.

G. H. FLETCHER and J. WATKINS, under the style of G. H. Fletcher and Co., Wolverhampton, iron hurdle, iron fencing and roofing, and tank manufacturers.

J. WOOLFORD, A. P. BROWN, and C. MEAKIN, under the style of J. Woolford and Co., St. Leonard's-road, Bromley-by-Bow, smelters and workers of ores and metals.

H. W. WARD, W. DEAKIN, F. W. HOWARD, T. W. WEBLEY, and H. WEBLEY, under the style of H. W. Ward and Co., Birmingham, machine tool makers.

THOMAS DREW, L. H. DREW, and T. D. BEAR, under the style of Rownson, Drew and Co., Upper Thames-street and Queen Victoria-street, E.C., and Prince's-wharf, Commercial-road, Lambeth, wholesale ironmongers, iron merchants, engineers, bridge, girder, and roof contractors, and also carrying on the business as manufacturers of stoves, ranges, fenders, fireirons, etc., and importers and makers of marble chimneypieces, under the style of George Wright and Sons.

THE BANKRUPTCY ACTS, 1883 AND 1890.

Receiving Order.

CHARLES INWOOD, Milton-next-Gravesend, engineer, millwright, and general smith.

Adjudication.

ROWLAND BROTHERHOOD, Victoria street, Westminster, civil engineer.

Commercial Gazette.

☞ The name given is that of the defendant; the amount is that for which judgment was given, and the date is that on which it was given.

County Court Judgments.

POWIS AND CO., Great Western-approach, Cardiff, engineers, £55 4s. 10d. 11th June.

W. G. F. WEBSTER, Alexandra Works, Folkestone, engineer, £18 6s. 5d. 14th June.

S. S. WELCH AND CO., 22, Walker-terrace, Plymouth, engineers, £21 12s. 3d. 10th June.

New Companies.

HOLLOWAY ELECTRICITY SUPPLY COMPANY LIMITED.—This company was registered on the 30th ult., with a capital of £2000, in £10 shares, to establish and maintain central and other stations from which electricity may be supplied, and to carry on in the parish of Islington and elsewhere the business of electric lighting in all its branches. The number of directors is not to be less than three nor more than seven; qualification, £500; remuneration, as the company in general meeting determine. Registered by Mr. W. Sharp, solicitor, 13, Walbrook, E.C.

HEPBURN AND GALE LIMITED.—This company was registered on the 30th ult., with a capital of £60,000, in £10 shares, to enter into an agreement upon the terms of an agreement dated June 8, 1892, between Hepburn and Gale Limited of the one part, and W. A. Posnett (on behalf of the company) of the other part; and to carry on the business of tanners, curriers, leather merchants, manufacturers of leather belting, hose pipes, and all leather articles for mechanical purposes. The number of directors is not to be less than three nor more than five, the first being Messrs. F. Gale, W. A. Posnett, T. Walker, and S. Barrow; qualification, 50 shares; remuneration as determined by the company in general meeting. Mr. W. A. Posnett is the managing director, with a salary of £500 per annum. Registered by Messrs. S. M. and J. B. Benson, 1, Clement's Inn, W.C.

WHALEBACK STEAMSHIP COMPANY LIMITED.—This company was registered on the 5th inst., with a capital of £250,000, in £10 shares, to acquire, charter, or build vessels of the type known as "Whalebacks," under patents granted in the United Kingdom, America, and other foreign countries, to A. McDougall and others; to build, purchase, hire, charter, work, exchange, or sell steam or other ships, vessels, lighters, barges, boats, coal hulks, wharves, warehouses, etc., and to carry on the business of merchants, shipowners, agents, shipbuilders, carriers, and warehousemen. The first directors are to be appointed at a meeting of the signatories; remuneration as the company in general meeting determine. Messrs. W. and E. Johnston, of Liverpool, are the managing directors, or managers. Registered by Messrs. William Johnston and Co. Limited, 23, Billiter-street, E.C.

THOMAS PIGGOTT AND CO. LIMITED.—This company was registered on the 2nd inst., with a capital of £90,000, in £10 shares, to acquire, take over as a going concern, and carry on the business of gas, water, and mechanical engineers belonging to and carried on by Messrs. Thomas Piggott and Co., and, with a view to such acquisition, to adopt an agreement dated June 24, 1892, between Messrs. S. S. Lloyd, G. H. Lloyd, A. L. Lloyd, and H. Bewlay of the one part, and Mr. C. F. Lloyd (for the company) of the other part, and an agreement dated June 24, 1892, between Mr. G. A. Everett of the first part, Mr. N. H. Everett of the second part, and Mr. C. F. Lloyd of the third part. The number of directors is not to be less than three nor more than seven; qualification, £1000; remuneration to be determined by the company in general meeting. Registered by Messrs. Davidson and Morris, solicitors, 40 and 42, Queen Victoria street, E.C.

RAILWAY ELECTRIC READING LAMP COMPANY LIMITED.—This company was registered on the 4th inst., with a capital of £100,000, in £5 shares, to purchase from the Railway Automatic Electric Light Syndicate Limited the patents for the United Kingdom for electric reading lamps, granted to Messrs. D. H. Davies and J. M. Tourtel; to enter into an agreement with the said syndicate of the first part, the said Messrs. J. M. Tourtel and D. H. Davies of the second part, and the company of the third part; and to enter into an agreement with the Metropolitan District Railway Company, by which the company will be authorised to instal and work automatic electric reading lamps in the carriages of the said railway. The number of directors is not to be less than three nor more than seven, the first being Messrs. E. Etlinger, J. H. Kincaid, C. E. Spagnoletti, and B. H. Van Tromp; qualification, 50 shares; remuneration, £800 per annum and 5 per cent. of the excess after the payment of a £7 per cent. dividend. Registered office, 1, Great Winchester-street, E.C.

Letters to the Editor.

*** *We do not hold ourselves responsible for opinions expressed by correspondents.*

*** *The name and address of the writer (not necessarily for publication) must in all cases accompany letters intended for insertion, or containing queries.*

*** *Letters intended for publication in the current week's issue must reach our Manchester Office not later than by the first post on the Tuesday preceding the date of publication.*

BIRCH'S SCREW-CUTTING LATHE.

To the Editor of THE MECHANICAL WORLD.

SIR,—Referring to Mr. W. H. Astbury's letter in your issue of July 8, the lathe in question is not a copy as he intimates, but is made from the original patterns, which we purchased, along with the right to manufacture, at Mr. Astbury's sale at the Clarendon Works, Manchester, some time ago, of which fact Mr. A. is well aware.

The drawings and patterns have been thoroughly overhauled by us, and the alterations have been much more extensive than would at first sight appear.

That we credited Mr. Astbury with having designed a good tool was evident, or we should not have purchased the patterns; still, the design as it came to our hands was amenable to much improvement, and we have spent considerable time and thought to this end, and are of opinion that this lathe is now much superior to the earlier design. G. BIRCH AND CO.

Salford, July 11.

DEVIATIONS FROM DRAWINGS IN THE WORKSHOP.

To the Editor of THE MECHANICAL WORLD.

SIR,—In answer to "One Who Has Experienced Both Sides," I am pleased to say that I have had a lively and varied experience as draughtsman and as foreman. The method suggested for gaining an expression of opinion from the shop foremen on any new departure in size or design has been proved, in my own experience, to be correct, and I can assure all interested that if adopted by draughtsmen and foremen, in a fair spirit, it will work admirably and benefit BOTH SIDES.

London, July 9.

A NEW COMPRESSION COUPLING.

To the Editor of THE MECHANICAL WORLD.

SIR,—I was surprised to see, in your issue of June 24, under the above heading, a sketch and description of a coupling which is said to be *new*. I have carefully compared it with the one Unwin describes in his "Machine Design," chap. 7, p. 207, 10th edition, and find it to be, with one small exception, quite similar. Perhaps the makers of this so-called new coupling may be able to reconcile their assertion with that described in Unwin's "Machine Design." R. A. H. P.

Aberdeen, July 11.

FUEL GAS.

To the Editor of THE MECHANICAL WORLD.

SIR,—In an article appearing in THE MECHANICAL WORLD on "Fuel Gas," a reference is made to a Mr. Kitson, who appears to have drawn largely from the literary work of Mr. Thwaite on this subject. The principle he employs of heating the air is essentially that of Mr. Thwaite, and is covered by patents held by this company. D. H. NOAR, Secretary,

The Gaseous and Liquid Fuel Supply Company Limited.

Manchester, July 10.

Miscellaneous Items.

Owing to the fact that counterfeit coins are bad conductors, Professor Elihu Thompson suggests the electric current as a means of detecting spurious money.

The total length of railways open to traffic at the end of 1891 in North Africa amounted to 1930 miles, the receipts during the year having amounted to £1,081,489. The receipts during 1890 were £1,045,204, when 1910 miles were open to traffic.

At three of the large London railway stations—Charing Cross, Cannon-street, and London Bridge—as many as 32,969 movements for signal and point levers have to be made every twenty-four hours, quite apart from the telegraphic operations.

The Isle of Man Exhibition of Manufactures, Science, and Art was opened on the 6th inst. by the Lieutenant-Governor, Mr. Spencer Walpole. The exhibition is situated at the Belle Vue Gardens, about a mile from Douglas. The buildings cover 100,000 square yards, and are lighted by electric light.

The new central station erected at Tivoli, about 20 miles from Rome, to be used in connection with the electric lighting of the latter place, was inaugurated on the 4th inst., in the presence of the Italian Minister of Public Works, when the current was transmitted to Rome, and employed in the lighting of the Via Porta Pia.

A new wood concrete has been invented in Germany. Shavings and planing mill chips, either of common or fancy woods, which may be stained before use if desired, are mixed with casein, calcined magnesian limestone, glycerine, silicate of soda, and a little linseed oil, and this is forced by hydraulic pressure into moulds, where it is allowed to harden. When dry the composition is strong and solid, and can be sawed, planed, polished, and varnished. It is expected that it will be found useful as an ornament in the shape of panels, or as a covering for entire wall surfaces.

Mr. F. H. Pearce, who for upwards of 40 years had been connected with the Bowling Iron Company, died very suddenly on the 29th ult., at Harrogate. When about nineteen years of age he was employed under his brother at Bowling, and in course of time was appointed mining engineer and manager of the collieries of the company. This appointment he held until August last, when he retired from the service of the company. He had been a member of the North of England Institute of Mining Engineers since the year 1857, and was made a vice-president of the Midland Institute of Mining Engineers in 1879. Mr. Pearce was a native of Stourbridge, and was in his sixty-first year.

The publisher of "The Mechanical World" will send a prepaid parcel of specimen copies to anyone, in any part of the world, who can distribute them advantageously amongst his engineering friends. Business card or bill-head should be enclosed as a guarantee of good faith, and number of copies stated.—Address: 391, Strand, London, or New Bridge-street, Strangeways, Manchester.

Prize Competition.

WE OFFER FOUR GUINEAS MONTHLY IN PRIZES FOR THE BEST ORIGINAL ARTICLES SENT IN ON ANY MECHANICAL, ENGINEERING OR ELECTRICAL SUBJECT.

IN ORDER THAT MANAGERS, DRAUGHTSMEN, FOREMEN, AND WORKMEN WHO HAVE HAD NO PRACTICE IN WRITING MAY NOT HESITATE TO SEND IN COMPETITIONS, IT IS TO BE UNDERSTOOD THAT ALL ARTICLES WILL BE FULLY EDITED AND CORRECTED, AND JUDGED OF SOLELY ON THEIR MERITS AS ORIGINAL CONTRIBUTIONS FROM A PRACTICAL POINT OF VIEW. THE OBJECT OF THE COMPETITION IS TO INDUCE PRACTICAL MEN TO COME FORWARD AND GIVE THE RESULTS OF THEIR EXPERIENCE.

CONDITIONS.

Competitions for our Monthly Prizes must be sent so as to arrive at the Manchester Offices of THE MECHANICAL WORLD, New Bridge-street, not later than the last Tuesday in each month. Articles arriving after that time will be placed in the following month's competition.

Written competitions must be on one side of the paper only. The contributions must be original, and relate to matters connected with Engineering, Mechanism or Electricity.

The Proprietors of THE MECHANICAL WORLD reserve the right to publish any competition, whether it gains a prize or not.

The competitions may be accompanied by diagrams, sketches or drawings.

Competitors should write the words "Prize Competition" on the envelopes.

Competitors are not confined to one, but may send any number of competitions.

The correct name and address of the sender *must* be distinctly written upon every competition, not necessarily for publication. Competitions can appear under a *nom de plume*.

☞ We cannot undertake to be responsible for any MSS. sent to us, though when stamps are enclosed for the purpose we will endeavour to return rejected contributions.

Queries.

☞ Readers are invited to avail themselves of this section for practical information on questions relating to Mechanical Engineering and the Scientific Industries.

☞ Queries and Replies should arrive at the Manchester Office not later than by the first post on the Tuesday preceding the date of publication.

MAKERS OF CELLULOID.—Required the names and addresses of extensive makers of celluloid.—B. P.

NICKEL.—In an alloy of cast iron and nickel what is the increase in strength over cast iron, and what proportion of nickel should be used?—T. C.

ALUMINIUM.—Will any reader inform me what is the greatest percentage of metal alumina has been found to contain up to the present date?—ALUMINA.

ECONOMISER SCRAPERS.—What means must I adopt to renew some broken scrapers in the middle of the range of pipes in the economisers?—PUZZLED.

PATTERNMAKER'S TOOL BOX.—Will any reader give me a sketch of the patternmaker's tool box, with full dimensions and particulars?—APPRENTICE.

FRICTION OF WATER IN PIPES.—What is the head of water in feet necessary to overcome the friction of a bend 10in. bore and 12in. radius; velocity of water, 170ft per minute?—VULCAN.

RIFLING MACHINE.—I should be glad of a sketch of any appliance used for rifling out small barrels, such as revolvers, etc., say ¼in. to ⅝in. bore, with threads, say, 6in. pitch.—NEMO.

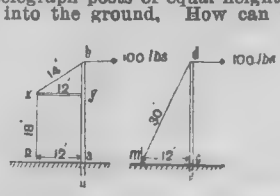
FEED-WATER HEATER.—Could anyone kindly give the square feet of heating surface for a 6in. feed-water heater, or the best allowance per I.H.P. of engine? What is the usual amount in a first-class heater, say Atkinson's or Berryman's?—P. H. S.

HOT-AIR ENGINE.—Will some reader of THE MECHANICAL WORLD kindly oblige me with a section and principal dimensions of a ½H.P. single-acting hot-air engine of the Stirling cycle?—GEO. H. PERKINS, North Queensland.

LINING BRASSES.—I have some brasses to line up with Babbitt's metal. Will some reader kindly tell me if they are cast in a sand box and turned up, or filled up around the journal, and what should be applied to keep the metal from adhering to the journal?—BABBITTS.

HEAD-GEAR FOR COLLIERY.—I have contracted to make a pitch pine head-gear for a colliery. The pitch pine is 16in. square, and the head-gear is to be 35ft. high; also, it has to be placed on either brick or stone pillars 15ft. high. Can anyone inform me of a good plan to get it to the top of these pillars, or will someone kindly show me how I am to get it into position?—ALPHA.

STAYING TELEGRAPH POSTS.—*a b* and *c d* are two telegraph posts of equal height, firmly fixed into the ground. How can *m d* be



proved to be a stronger way of staying than *n x b*? Also, what is the compressing thrust on the strut *x y*, and the bending moment about *y*?—TELEGRAPH POST.

WATER FLOWING INTO JET CONDENSER.—Will some fellow-reader kindly give me a worked-out example of the quantity of water that will flow through a 4in. pipe 30ft. long, with four bends, into a jet condenser with 18in., 24in., and 28in. of vacuum; wheel valve wide open, giving same area as pipe; also with it half open? The water supply tank is 8ft. below condenser. The condenser is working on a set of triple-expansion engines. What effect have bends and temperature on supply water?—SUGAR MILL, North Queensland.

LOCOMOTIVE CONSTRUCTION.—Will any correspondent enlighten me as to the mode adopted in locomotive work in order to fix the position of the axles (horizontally) so that each axle may have a pre-determined portion of the total weight resting upon it? Say:—

Load on leading axle	.....	0·32
„ driving „	.....	0·48
„ trailing „	.....	0·20
		1·00

Of course, I am aware there are certain circumstances—such as length of barrel, position of firebox, etc.—which in practice to a great extent influence this, but the point I wish clearing up is: Given the total weight, how are the positions of axles determined so that the pre-arranged weights rest on them? An answer would be of service to others as well as to—HILLSLAND.

COLLIERY HAULAGE PLANT.—I should be very pleased if some reader would give me some information on the following subject. In laying down a plant for endless rope haulage at a colliery the following data are given:—The engines are fixed at the pit bank, at a distance of 20yds. from the shaft. The shaft is 200yds. deep. Ropes are carried down shaft in wooden boxes. Said ropes are 1¼in. round steel. From the pit bottom the haulage extends a distance of 3000yds. Starting at the end farthest from the pit bottom, the road rises 1 in 20 for 300yds., then 1 in 14 for the next 200yds., then it is level for 100yds., then a fall towards the bottom of 1 in 30 for 200yds., then a rise of 1 in 5 for 300yds. and the remaining 1900yds. has a rise of 1 in 21. The speed of the rope is 1½ miles per hour. The weight of the corves is (empty) 4cwt., and each corf contains 8cwt. These are hung on the ropes in pairs at a uniform distance of 10yds. apart. The empty corves are hung in the same way. The driving pulley on engine to be about 6ft. diameter. The boiler pressure is 50lb. The rope runs over the corves, and in the 3000yds. each rope has 10 holding-up pulleys. What I should like to know is how to calculate the H.P. required to run the haulage; also how to calculate the size of engines and gearing to develop a H.P. having sufficient margin for same; also what margin is necessary? In this arrangement the road is pretty straight. What difference would it make to the power required, supposing there is a curve in the roads containing an angle of 135°?—NOVICE.

Replies.

☞ Owing to the constant increase in our correspondence we regret that we have no alternative but to announce that we cannot reply by post to Queries even when stamped envelopes are sent.

☞ Queries and Replies must in all cases be accompanied by the names and addresses of the writers, as no notice will be taken of anonymous communications.

R. BOWMAN.—See reply to J. P. Corden.

IRONWORK.—Apply to Messrs. Francis Ley and Co., Derby.

ENGINEER.—Try Calvert's "Practical Notes on Screw Cutting," 2s. 6d., to be had from our office.

J. P. CORDEN.—We cannot undertake to forward letters unless a stamped envelope is enclosed.

T. M. R. (S. Wales).—We would advise you to first procure a copy of Mr. C. Graham-Smith's address on the "Education of a Civil Engineer." 1s. 6d.

MODEL.—There are a number of foundries in Sheffield who would cast such a cylinder for you. You do not give the piston speed, but assuming this to be about 300ft. per minute, the area of the steam port should be about 3sq. in.; exhaust port 4½sq. in.

INDICATOR, W. W.—(1.) The length of stroke has nothing to do with the scale used. (2.) Yes, the pressure in lb. per square inch is measured by the small scales supplied with the instrument. (3.) In a 90 scale, 1in. represents 90lb. pressure, so that 1lb. would be represented by $\frac{1}{90}$ of an inch; whether your scale is divided as finely as this we cannot say. (4.) Yes, the same remarks apply to the measurement of pressures above and below the atmospheric line. You will find much practical information in our issue for April 26, 1890.

CONICAL TANK.—A tank in the form of a conical frustum is made 12in. deep, to hold 13 ale gallons when full; the diameters are to be in the proportion of 5 to 3. Will any reader give a rule or formula to find the diameter?—MECHANIC.—*A.*—In reply to "Mechanic's" inquiry I think the following will help him:—Let V = volume of tank, D = larger diameter,

d = smaller, h = depth. $D = \sqrt{\frac{V \times 12}{\pi \times h \times 1{\cdot}96}}$; V = 13 ale gallons = 3604·562 cubic inches; h = 12in.;

$D = \sqrt{\frac{3604{\cdot}562 \times 12}{\pi \times 12 \times 1{\cdot}96}} = 24{\cdot}2$in.; $d = \frac{3}{5}$. D = 14·52in.

—H. St.

Latest Inventions.

APPLICATIONS FOR LETTERS PATENT.

When Patents have been "communicated," the name of the communicating party is printed in italics.

Where complete specification accompanies application, an asterisk is suffixed.

27th June, 1892.

8612A PURIFICATION of IRON. E H Saniter.
11,921 PRODUCTION of HOLLOW METAL INGOTS. G Hatton.
11,928 GAS ENGINES. W Le Plastrier Webb.
11,935 LATHES. C M Linley.
11,936 STARTING GEAR for GAS ENGINES. D Clerk.
11,941 ELECTRICITY METERS.* H W Miller.
11,945 BRAKES and BRAKE MECHANISM. E G Brewer. (*J D Georges*, France.)
11,947 BALANCED VALVES. T W Barber.
11,948 ELECTRIC FIRE-ALARM and CIRCUIT-CONTROLLING THERMOSTAT and CLOCK MECHANISM.* H Cortland.
11,950 PUMP for FORCING or PROJECTING WATER.* J Pilecka.
11,951 ASCERTAINING the LEVEL of FLUIDS in BOILERS. J D Churchill.
11,952 ELECTRIC METERS. J W Jones.
11,956 AUTOMATIC SPRINKLER. G W and L A Edwards.
11,960 LOCKING NUTS on BOLTS.* J Evinof.
11,961 LUBRICATORS. D Deody.
11,962 ENGINES ACTUATED by the EXPLOSION or BURNING of COMBUSTIBLE MIXTURES. J W Hornsby and others.

28th June, 1892.

11,981 NAIL-MAKING MACHINERY.* A G Brookes. (*J W Brookes*, United States.)
11,987 MACHINE for CLEANING STEAM-BOILER FLUES.* P S Kingsland.
11,991 MARINE ENGINES. W C Wallace.
11,992 COMBINED FEED-WATER HEATER, CONDENSER, and OIL SEPARATOR.* E Nelson.
11,993 SECTIONAL SURFACE CONDENSERS.* E Nelson.
11,996 STEAM ENGINES.* J M Anderson.
11,997 MECHANISM for ACTUATING SIGNAL WIRES. J Fisher.
12,001 ANEROID BAROMETERS. L Comitti.
12,005 CALCULATING MACHINES. M Hearn.
12,015 MARINERS' COMPASSES.* R Oliver.
12,017 SMOKE-CONSUMING FURNACES.* G S Riley.
12,025 RAILWAY and TRAMWAY RAILS.* O Imray. (*The Johnson Company*, United States.)
12,026 CONSTRUCTION of TRAMWAY or RAILWAY RAILS. O Imray. (*A J Moxham*, United States.)
12,027 CROSSINGS or SWITCHES for RAILWAY and TRAMWAY RAILS.* O Imray. (*The Johnson Company*, United States.)
12,028 EXPANSION JOINTS for RAILWAY and TRAMWAY RAILS.* O Imray. (*A J Moxham*, United States.)
12,031 SEPARATING METALLIC from NON-METALLIC SUBSTANCES. C Raleigh.
12,032 STAMP BATTERIES and PULVERISING MACHINES. C Raleigh.
12,039 CONSTRUCTION of ELECTRIC RAILWAYS. T Floyd.
12,040 ARC ELECTRIC LAMPS. J E A Gwynne.
12,044 AUTOMATIC SUPPLY of ELECTRICITY. G H Jones.
12,054 EXTRACTING HEAT FROM the PRODUCTS of COMBUSTION in STEAM BOILERS. T Mudd.
12,059 PIPE THREADING MACHINES.* W P Thompson. (*J B Z Dumais*, United States.)

29th June, 1892.

12,065 BENDING METAL PIPES or TUBES. H P Fenby.
12,070 VALVE GEAR. W J Llewellyn and J Bate.
12,081 FRICTION and PULLEY CLUTCH. W Ambler and W J Warren.
12,086 TOOL HOLDERS for PLANING MACHINES. B H Mallinson.
12,087 ELECTRIC HEATING DEVICES and CONTACTS for the SAME. F W Schindler-Jenny.
12,099 MEANS for CLEARING the GROOVES of TRAMWAY RAILS. J R Purssell.
12,105 AUTOMATIC BALL VALVES.* R Garratt.
12,108 COMBINATION TOOL. J M'Cool.
12,112 PROPULSION of SHIPS. J M Lainé.
12,122 MICROPHONE MECHANISM. C A M'Evoy.
12,125 POWER HAMMERS. J C Fell. (*W H Law*, Canada.)

30th June, 1892.

12,129 FURNACE or TUBE for MARINE or LAND BOILERS. L D Hoggart.
12,130 PACKINGS for HYDRAULIC RAMS. P Nolet.
12,133 FUEL ECONOMISERS. R Johnson.
12,134 FEED-WATER HEATING ARRANGEMENTS. R W B Sanderson.
12,142 FEED-WATER PURIFYING ARRANGEMENTS for STEAM BOILERS. R W B Sanderson.
12,144 TUBES and OTHER HOLLOW CYLINDERS. G Hookham.
12,147 AFFIXABLE TUYERE NOZZLE. E Burns.
12,154 CRANK MOTION. H W Horne.
12,159 SIGHT-FEED LUBRICATORS for STEAM ENGINES. T Wilcox and F L Broughton.
12,165 GAS and OIL MOTOR ENGINES. F H Anderson.
12,172 MACHINES for FORMING SCREW-THREADS in MOULDS for CASTING SCREWS and WORMS.* H H Lake. (*Die Actien Gesellschaft Grusonwerk*, Germany.)
12,173 COUPLINGS for RAILWAY VEHICLES.* H H Lake. (*E H Gillman* and *G H Barnes*, United States.)
12,183 GAS ENGINES. A J Boult. (*J A Charter*, United States.)
12,184 WOOD PULLEYS. R Kerr and others.
12,186 WOOD PULLEYS.* R Kerr and others.
12,191 ELECTRIC RAILWAYS.* B J B Mills. (*E H Johnson*, United States.)

1st July, 1892.

12,209 HEATING of HOT WATER, STEAM, and OTHER BOILERS. R P Fisher.
12,212 ELECTRIC REGULATING APPARATUS. J M Bradford.
12,225 APPARATUS for REGULATING and REVERSING GEAR for STEAM ENGINES. B W Raine and W H Wright.
12,231 RAILWAY CHAIRS. G E Hitchenor and C W St. Lawrence.
12,238 APPARATUS for PRODUCING and UTILISING ELECTRIC CURRENTS.* B Scheithauer
12,246 ELECTRICAL METERS. Y A M P Goubaux.
12,253 FIRE BRIDGES for FURNACES.* H Kowitzke.
12,254 TOOL. W Pullen and R Briggs.
12,255 MACHINES for CRUSHING STONE, ORES, and the LIKE. M E Villeroy.
12,258 ELECTRIC GLOW LAMP. P Scharf.
12,259 BOAT DAVITS. A Anderson.
12,262 WOOD-WORKING MACHINES or DEVICES.* S J Shimer.

2nd July, 1892.

12,263 MECHANICALLY FIRING FURNACES. E J Newitt.
12,264 FURNACE FIREGRATES and BARS THEREFOR. E J Newitt.
12,265 ACTUATING the FIREBARS of FURNACES. E J Newitt.
12,273 HEATING WATER by MEANS of EXHAUST STEAM. J W Martin.
12,274 CLEANING ROLLED WIRE from SCALES and OXIDES and of ANNEALING the SAME.* P Delseil and others.
12,286 AUTOMATICALLY REGULATING the SUPPLY of AIR to STEAM BOILER FURNACES. G Edgar and J Saxton.
12,289 STEERING GEAR. S Alley and J A MacLellan.
12,306 CONSTRUCTION of SECONDARY BATTERIES for ELECTRICAL STORAGE PURPOSES.* J B Lee.

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FRIDAY, JULY 22ND, 1892.

Provisional Protection of Inventions.

THE system of provisionally protecting inventions in this country, as at present carried on, has many advantages over some of the systems of industrial protection in use abroad, but it is a debatable point as to whether those advantages are not outweighed by the defects inherent in the system. Now and again we hear some discontented note expressed either by members of the Chartered Institute of Patent Agents or by some more than usually intelligent inventor who has the pluck to cry out when he has suffered some pecuniary injury resulting from the present system. Early in 1886 Mr. Lloyd Wise, a well-known patent agent in London and now president of the above-named institute, wrote an article which appeared in our contemporary, "Engineering," on the provisional protection of inventions, in which he pointed out the disadvantages under which inventors suffered. Chief amongst these, it may be mentioned, at that time was the system whereby one of the duties of a patents examiner was to compare different applications for patents having similar titles and to notify the respective applicants of any seeming interference. The first applicant, oftener than not, used the examiner's report as an argument in his favour when the question of interference came to be argued out during the opposition stage, although the grounds of opposition were in reality only based upon such a vague document as the provisional specification. By the Act of 1888, however, this system was abolished and a fresh enactment provided which, though an improvement on the old method, still leaves much to be desired. In the article referred to the author pointed out the inability of the inventor to sue for damages, during the term of protection of his invention, anyone who desired to infringe on the embryo patent, which inability exists at the present time, and is the cause of much annoyance and expense, for before the inventor can sue it is necessary that he file a complete specification as soon as he finds out the infringement, and then he has to await its acceptance before legal action can be taken. Even after the complete specification has been accepted his remedy is only partial, for he can only claim damages for what is done after such acceptance. In addition to the above defects of the law, there is another and still greater one. We refer to the completion of a patent before the term of protection has expired, which has been applied for at a subsequent date to another of a similar nature, whereby the first applicant, if he be so disposed, takes advantage of the information contained in the patent so completed, and uses it to his own advantage in the completing of his own patent. The second inventor, who has perhaps claimed something valuable in his patent which had never perhaps been thought of by the first inventor, is thus at the mercy of the latter, who, on account of the vagueness of his provisional specification, is able to construe that document as an anticipation of what is contained in the second specification. At a recent meeting of the institute before named, we find Mr. John Imray, a past president, expressing up to a certain point the views previously laid down by Mr. Wise, and in enlarging upon these views he referred to the clause in the statute wherein it is stated that a "provisional specification must describe the nature of the invention," though what is to be held to constitute the nature of the invention can only be to a certain extent cleared up by contrasting that bald prescription with that at the head of the complete specification, which states that the latter must not generally, but "particularly describe and ascertain the nature of the invention, and in what manner the same is to be performed." Mr. Imray further referred to the construction put upon the clause in the provisional specification by the learned judges, most of whom, he said, concurred in the view that the office of the provisional "is to describe so much of an invention as will enable one to identify it, while the complete specification must go much farther, describing fully how the invention is to be carried into practical effect, and clearly distinguishing it as a new invention from inventions relating to the same subject which have gone before." After a clear exposition of the defects of the system of provisional protection, Mr. Imray concluded his paper by saying that when looked fairly in the face, it is useless when applied justly, and more than useless when it is applied unjustly. At the conclusion of the paper, the president of the institute pointed out that in other important countries the inventor enjoys peculiar facilities not afforded to him here, and if the system of provisional protection were abolished, without providing some alternative mode of securing developments, the British inventor would be placed at a serious disadvantage. We quite agree with Mr. Wise that some scheme should take the place of the present, but not the alternative scheme that he suggests, which is practically as vague and absurd as the present, inasmuch as his proposal to enlarge the powers of amendment by the substitution of one specification for another would in our opinion lead to endless confusion and annoyance, whilst the insertion of a clause to the effect that "it should not be a ground of objection that the specification as amended would claim an invention substantially larger than, or substantially different from, the invention claimed in the specification as it stood before amendment," would enhance the difficulty, and only serve to line the pockets of junior counsel, without conferring benefit upon those who need it most. The whole system of industrial protection requires rearranging and making less complicated than the bungling, cumbrous machinery of inefficiency and costliness at present employed.

An Electric Canoe.

NOW that electric launches have become popular, attention is being turned to electric canoes. The first has just been constructed by Messrs. Woodhouse and Rawson, who have named it the "Flash." This is a new departure. The canoe is 18ft. long, by 3ft. 9in. beam, with a draught of about 1ft., and will carry four persons. She is built of mahogany, and is fitted with a ½H.P. motor, energised by Epstein accumulators. At the trial which took place recently, the "Flash" attained a mean speed of over six miles an hour. This canoe was shown at the recent Henley Regatta, when it was controlled and operated very easily.

Mr. Cyrus Field.

ON Tuesday, the 12th inst., the death of Mr. Cyrus Field was announced. The deceased gentleman was born on November 30, 1819, at Stockbridge, Massachusetts, and after a successful commercial career devoted himself to submarine telegraphy, and did more than anyone now alive to establish telegraphic communication between this country and the United States. His first venture was the construction of a line from the coast of Ireland to that of Continental America by way of Newfoundland, and this involved also the erection of an overland telegraph line in that colony. He gave the closest personal attention to the great undertaking, which was not easily accomplished, accompanying various expeditions himself, and crossing the Atlantic, it is said, about 50 times. He was honoured by a unanimous vote of thanks from the Congress of the United States. Of the latest undertakings with which he identified himself may be mentioned the elevated railway system of New York.

The Epstein System of Electric Traction.

ATTENTION was recently drawn by Mr. L. Epstein to electric traction for tramcars by the use of the secondary battery invented by himself. This accumulator, unlike other cells, is composed of only three electrodes, which are arranged in an ebonite box. The active parts of the cells are produced out of the original substance of the lead itself, one cell weighing with acid about 45lb. There is no paste used in the manufacture of the cells; and the great point, Mr. Epstein stated before the Tramways Institute, was that the so-called active material could not become detached, and that, therefore, there was no risk of material dropping off and damaging the accumulators when in use. The weight of a complete battery, as ordinarily used in tramway work, would be about 2 tons, comprising 96 Epstein cells. According to the author, this battery would suffice to run a car at an average speed of 7½ miles for about four hours, leaving reserve to provide for emergencies. This was based upon the assumption that the average expenditure of the battery would be 6H.P., but by discharging the cells in two hours 12H.P. could be obtained. Figures were adduced to endeavour to show that by the use of the Epstein accumulator instead of horses for tramway work, a saving of about one-third in the cost per car mile would be effected; that the percentage of total working and general expenses, as compared with total receipts, would be reduced from 75 to about 54 per cent.; and that the dividend would be increased from 8½ per cent. in the case of horses to 25 per cent. with accumulators. These figures look well on paper, but Mr. Epstein believed that there was no reason to doubt that they—at least, very nearly—expressed the truth. As far as the cost of maintaining the batteries is concerned, the author did not anticipate that it would be more, at the outside, than one penny per car mile. Mr. Epstein then drew a comparison between the accumulator and the trolley systems, and stated that the efficiency of the former was much higher than that of either the trolley or underground method. In conclusion he referred to some tests which he had carried out with the accumulator, and which he said would give a total efficiency on the car axle of 47 per cent. In the discussion which followed the reading of the paper it was mentioned that the figures given were purely hypothetical, but Mr. Epstein stated that he was prepared to stand by them, and that he would doubtless at some future date furnish data to be obtained from the actual working of his accumulator on different tramways. These results will be looked forward to with interest.

Lloyd's Shipbuilding Returns.

THE returns compiled by Lloyd's Register of Shipping show that, excluding warships, there were 447 vessels, of 778,462 tons gross, under construction in the United Kingdom at the close of the quarter ended June 30, 1892, against 530 vessels, of 769,300 tons, at the close of the corresponding quarter of 1891. Comparing the present returns with those for the quarter ended March 31, 1892, a decrease is observed in the tonnage of vessels under construction of nearly 65,000 tons. This decrease has taken place chiefly in respect of sailing tonnage, which, however, remains at the high proportion of nearly 19 per cent. of the work in hand. Considerably more than half the sailing tonnage (or over 80,000 tons) is being built on the Clyde; about a quarter is distributed between the districts of Belfast, Leith, and Liverpool; leaving only about 30,000 tons under construction at all the remaining shipbuilding ports of the United Kingdom. It is remarkable that, of the very large total of 433,000 tons which is under construction on the North-east Coast, the sailing tonnage only amounts to about 10,500 tons, or under 2½ per cent. A very considerable falling-off from last quarter's figures is observed in the returns of vessels for the construction of which preparations are being made. At the end of March, 1892, there were reported 118 vessels of 223,276 tons as preparing; the present returns show 77 vessels of 123,249 tons, or not much over one-half the previous tonnage. In fact, the tonnage preparing is now less than it has been at any date since June, 1890. With the exception of that time so low a figure as the present has not been touched since September, 1887. The high proportion of sailing vessels which has prevailed of late is more than maintained in the vessels which are about to be put in hand. Of the tonnage under construction in the United Kingdom at the end of March, excluding that being built for foreign owners, 93 per cent., and of the tonnage being built for foreign owners, 95 per cent., was under the supervision of the surveyors of Lloyd's Register with a view to classification by the society. Of the total vessels under construction in the United Kingdom, 397, of 725,472 tons, or over 93 per cent. of the tonnage, were under the society's supervision. In addition to the foregoing, 21 vessels, of 26,309 tons, are reported as building abroad with a view to classification in Lloyd's Register Book.

MINING PUMPING ENGINES.

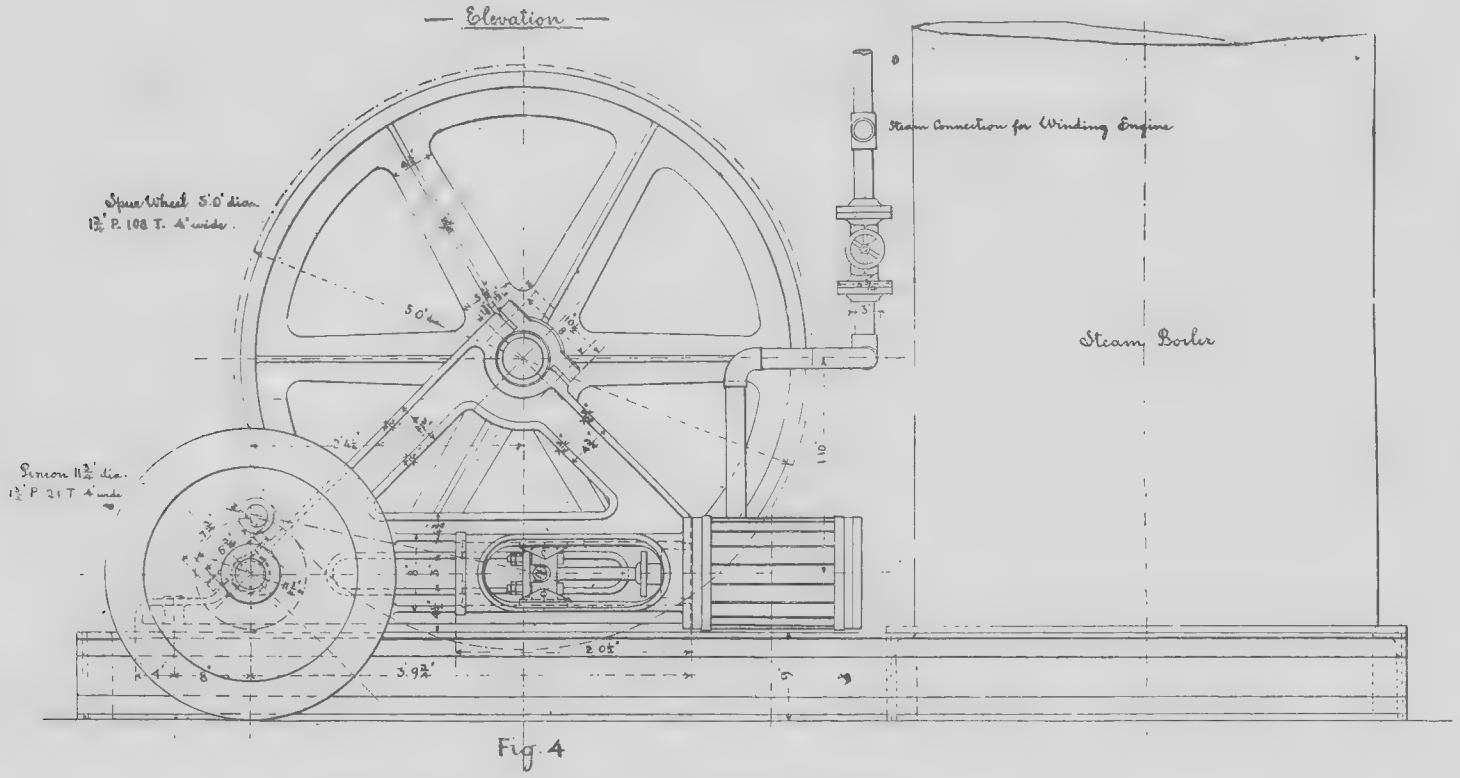


Fig. 4

7" dia. x 12" Stroke Mining Pumping Engines.

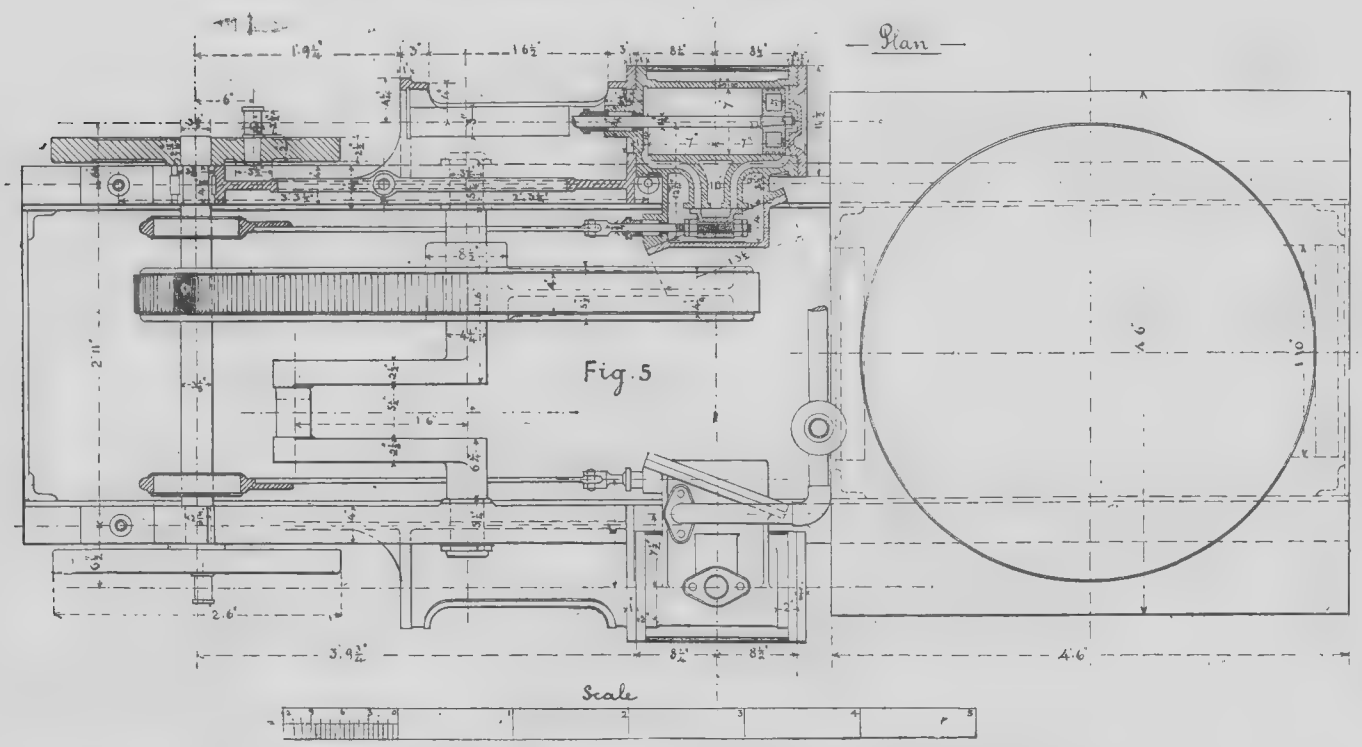


Fig. 5

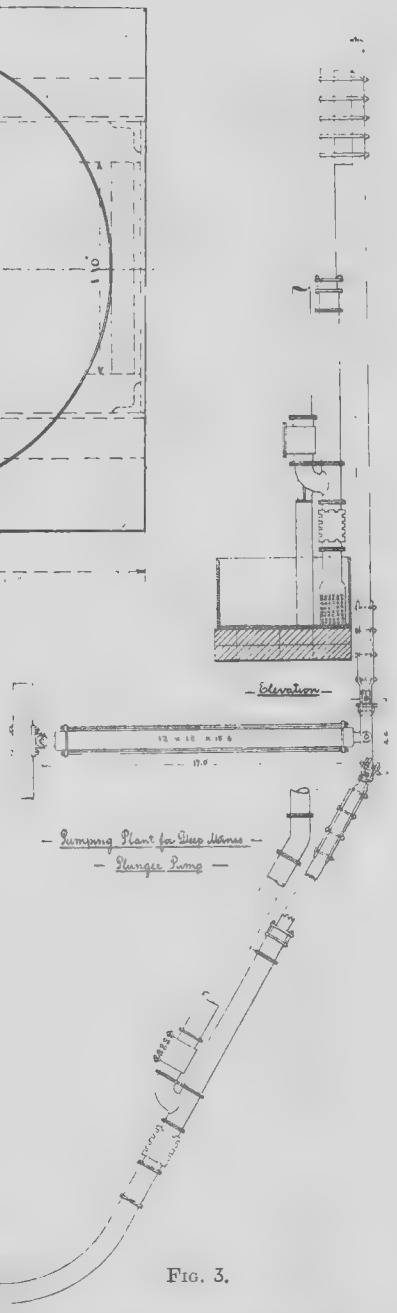


Fig. 3.

Mining Pumping Engines.

[CONTRIBUTED.]

(*Concluded from page* 19.)

THE engine works with a boiler pressure of 60lb. per square inch, and it runs at a speed of 150 revolutions per minute. The crank wheel makes 13 revolutions, and the pump 13 single strokes per minute, the pump being single-acting.

The approximate quantity of water delivered by this pump per minute, and with the longest stroke on the crank wheel—viz., 5ft. 6in.—is 116 gallons (calculated on an average efficiency of 75 per cent.), and this to a height of about 200ft.

When sinking a new shaft, the shortest stroke of 2ft. may only be required, and the height to which the water has to be raised much less. It is therefore advisable with every pump of this kind to have such an arrangement as indicated in Fig. 1 (p. 18).

The engine must always be of ample power, and all the details of the pump and pump rods should be made ample. For work of this kind it is absolutely necessary that everything should be sufficiently strong.

All flanges of the pump barrel, clack pieces, and pipes should be well bracketed between the bolt holes, and the bolt holes cored square to receive square-neck bolts. These bolts have square heads and nuts; it is understood that for timber connections large square washers must be used. All flanges are planed and grooved for the insertion of packing, to form good joints

The pump barrel is in ordinary cases made of cast iron, truly bored out the whole length to receive the bucket. With corrosive water, the inside of the barrel should be lined with gun metal or other non-corrosive material. Wood as lining has been found to answer very well.

The usual clacks used for these pumps are the Cornish valves. They are of the hinged type, with leather faces. These are considered to be the simplest, most easily repaired, and least liable to injury in working with the worst kind of water. The hinges upon which the valve turns are free to rise a short distance in vertical guides, thus allowing the water to escape all round.

Another similar form of valve, and of more recent construction, is illustrated by Fig. 6 in sectional elevation, and Fig. 7 in sectional plan. The clacks are shown fixed in position in the so-called clack piece; the door in this case is hinged, instead of being entirely secured by bolts as in Fig. 2. The leather valves are riveted between two cast-iron semi-circular plates to give sufficient stiffness to withstand the pressure.

The proportions indicated in Figs. 6 and 7 are based upon the unit x = the thickness of the valve seat, which is obtained from the formula

$$x = 0{\cdot}2 + \sqrt{\frac{D}{25}},$$

where D represents the internal diameter of the valve seat in inches. The valve seat is of cast iron, turned and fitted into its place, and the edges of the seat chamfered to prevent cutting of the leathers. The clacks are held in position by a crossbar bolted through the middle portion of the valve seat, and a projection on this bar is provided to prevent the clacks rising too high.

Figs. 8 and 9 show the form of bucket, corresponding in general design to that of the valves. The proportions indicated on the sketch are based upon the unit

$$x_1 = \left(0{\cdot}25\sqrt[4]{\frac{D}{25}}\right) - 0{\cdot}12,$$

where D represents the outside diameter of the bucket or the bore of the barrel.

The clacks are kept in position by a top crossbar, which in its turn is kept down by the bucket rod; the bucket rod is round, but is forged rectangular, with rounded corners where it passes through the top crossbar, the bucket, and the bottom bar; the reason for this is clearly shown by the illustration. A cotter is driven through the bottom of this bar; it holds the ring, the packing, the top crossbar, the valves and the bucket together, and the rectangular section of the rod is made equal to the area of the round rod, its strength being, therefore, thus maintained all over; the cotter should be provided with about three pin holes for adjusting, or two cotters driven in from opposite directions may be used.

The leather used for the valves must be thick, oil dressed, and of the best quality. In ordinary cases the packing used for the bucket is also of leather; with corrosive water, cast-iron packing rings are advisable. Birch-wood packing rings for corrosive and gritty waters have been found very

serviceable; they are economic in the first instance, and very easy to replace.

The pump rods are called in a general way "spears." Those working inside the pump (when of wood) are "wet spears," those working outside "dry spears." They are usually made of straight-grained red pine; the wrought-iron straps have brasses, keys, gibs, and pins fitted in a similar

Fig 6

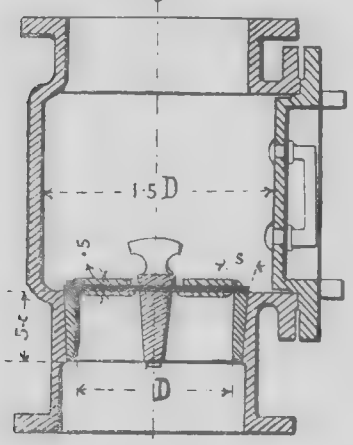
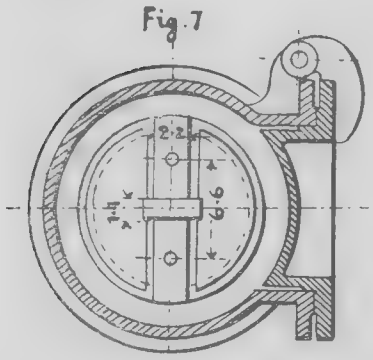


Fig. 7



way as in an ordinary connecting rod. The straps should taper down at their ends to about ½in. in thickness. The intermediate spears vary in length from 25ft. to 50ft., usually about 40ft. long, and they are made in equal lengths so as to be interchangeable. Their number varies according to their length and the depth of the shaft; they are well half-lapped and firmly joined together by plain wrought-iron straps, two to each joint (or, better, four to each joint), and in opposite directions, in this

Fig 8

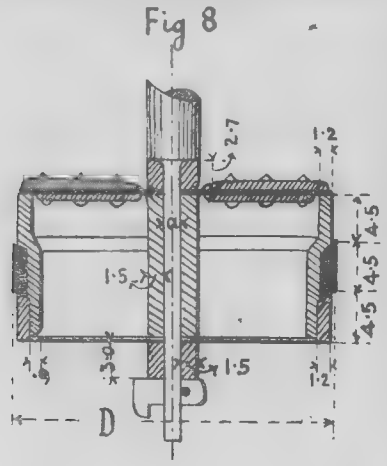
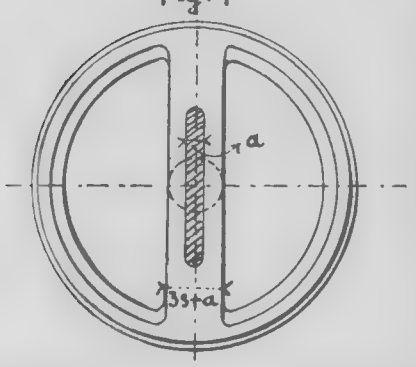


Fig. 9



case about 5in. wide and 1¼in. thick, tapering down to ½in. in thickness. They are made up to 15ft. long, and in this case about 9ft. long with 10 square-neck bolts, preferably fixed zig-zag.

To prevent the intermediate spears from twisting round during the stroke, and to keep them steady in the shaft, they are provided at intervals with timber collarings or guides fixed in the sides of the shaft. The arrangements of these collarings are various. One way is shown in Figs. 1 and 2 in plan and elevation. To maintain a good working of the pump these guides should be kept in good order.

Stages of wood or iron should be fixed in the shaft at each 10ft. to 18ft., and provided with ladders, to allow of easy and rapid access to the rods, clacks, and pump. The counterweight box is to balance the weight of the spears.

For deep mines the lift is, as a rule, subdivided to reduce the pressure on the rising main and working barrel; this is done by a series of plunger pumps placed one above the other, or by a bucket pump at the bottom and a series of plungers above, placed at distances varying from 100ft. to 200ft., or even more. At the bottom is placed the drawing lift, by which the water is lifted a height of about 60ft. into a cistern and the first plunger lift, from which point it is forced by a plunger up the rising main to the second lift, and so on until it reaches the surface.

In sinking in metalliferous lodes the underlie frequently changes. Under such circumstances "fend off" or "holdback" bobs are required to enable a new direction to be given to the main rod.

Fig. 3 illustrates the type of pump just described. It is an arrangement of an 8in. diameter Cornish plunger pump with bearing-off bob, and 8in. diameter Cornish plunger pump for lower levels of underlay shaft. V bobs are also used for this purpose.

The top of the pump's stroke should not be more than 28ft. above the lowest point of the water in the shaft. But it is desirable to have it less than that; and at places high above the sea level, where the pressure of the atmosphere is less, the vertical height of the suction must necessarily be less. The distance of horizontal suctions, provided the joints are tight, does not affect the pump very much.

It is advisable to have a catch valve in the vertical pipe, and one or more in the horizontal pipe, according to the length of the suction pipes.

A rose or strainer should always be fixed at the bottom of the pipe to prevent grit or dirt getting into the pumps. The suction and delivery pipes may be equal in area to the pump barrel; the suction is found to answer better if made a little larger than the delivery. It is always advisable to work these pumps at a slow speed. For 3in. and 4in. diameter barrels, 30 double strokes; for 5in. and 6in. diameter, 28 strokes; for 7in. and 8in. diameter, 26 strokes; and for 20in. diameter, 8 strokes.

Figs. 4 and 5 represent a drawing of a very useful pair of 7in. by 12in.-stroke horizontal mining pumping engines. The sweep rod is attached to the wrought-iron crank of the engines and to the pump bob. The engines are fixed on a wrought-iron girder frame, upon which a vertical boiler is also fixed, thus making the whole a very neat and compact arrangement.

For any further practical details of these mining pumps, the reader could not do better than consult P. Björling's able articles on "Details of Pump Construction," which appeared in THE MECHANICAL WORLD in 1891, and which have been omitted here to avoid repetition.

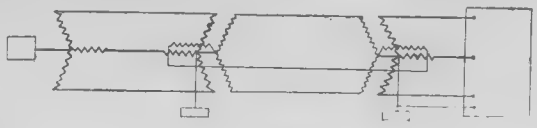


Fig. 21.

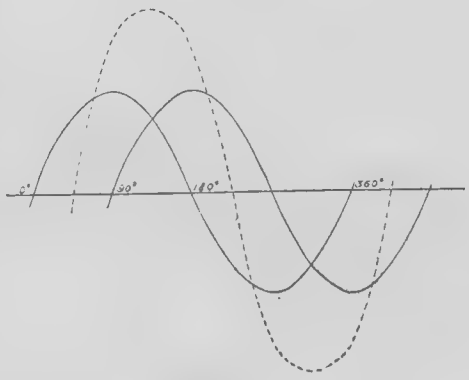


Fig. 22.

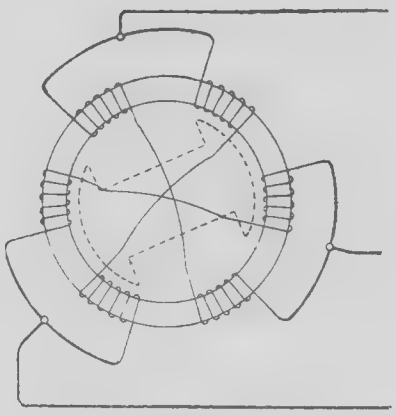


Fig. 23.

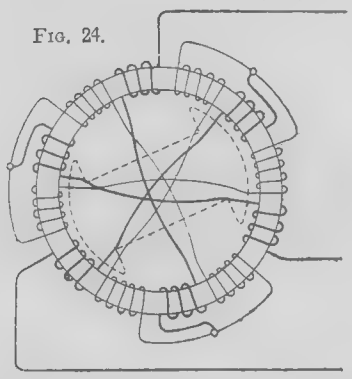


Fig. 24.

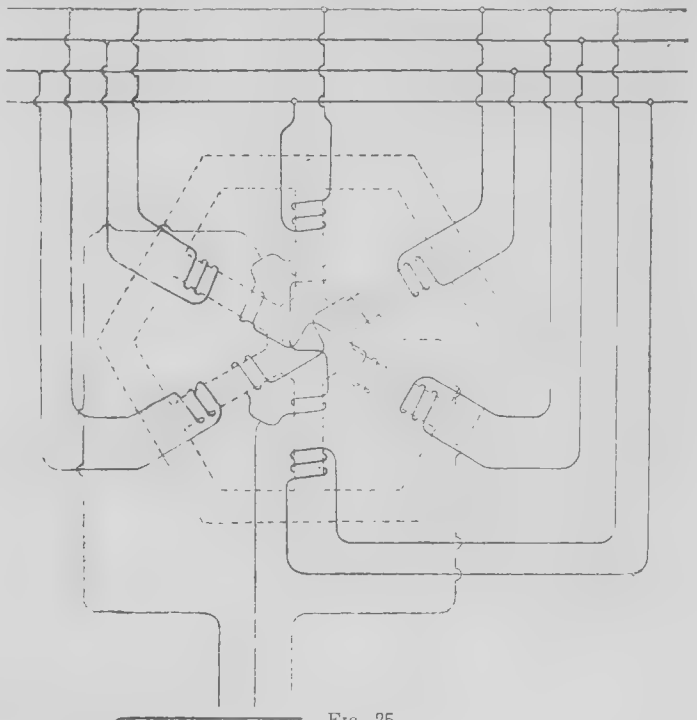


Fig. 25.

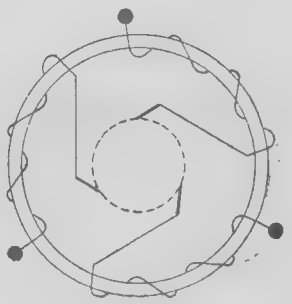


Fig. 26.

The Development of Divergent-phase Electric Machinery.

(*Concluded from page 304, vol. xi.*)

THE transformers used in the Lauffen-Frankfort experiments do not differ essentially from ordinary alternate-current transformers. They are of the "closed magnetic circuit" type, and consist of three laminated cylindrical iron cores, which are closed at the top and bottom by yokes, also of laminated iron, and surrounded by thick and thin coils. The inner ends of the tranformer coils, at both ends of line, are connected together, and the free ends of the fine wire coils pass through thick glass tubes so as to avoid contact between them and the cast-iron casing filled with petroleum in which they are placed. The casing is connected with earth and with the neutral point. The coils of the dynamo and motor are also similarly connected.

Fig. 21 shows these connections, and needs no further explanation.

The connection of the dynamo and motor to the transformers and the line is of the usual kind obtaining when a current is first transformed "up" and then "down" for transmission purposes. In this case, however, the transmission of the currents was effected by only three wires, which had to be specially insulated, and extra precautions taken on account of the high tensions used.

The transformers were constructed so as to transform 200 kilowatts, the maximum output of the dynamo, and have a coefficient of transformation of 160, so that if there is a potential difference of 50 volts at the terminals of one of the primary circuits there will be a potential difference of 8000 volts at the terminals of the corresponding secondary circuit. This latter value is the potential difference existing between the neutral point and each of the wires, but does not represent the potential difference between any two of the wires, which is greater—namely, $8000 \times 2 \sin 60°$, or a little over 13,850 volts.

The report of the committee entrusted with conducting these experiments has not yet been published, but some particulars of them have been given in a foreign journal by Herr Huber, an official of the Oerlikon works.

It appears that the transmission was effected at a pressure of 16,000 volts in the first instance, which was later on increased to 30,000 volts. Simultaneous experiments were made at Lauffen and Frankfort. At Lauffen there were currents of 500, 490, and 500 ampères in the three wires, and as there was a potential difference of 54 volts between each of the leads and the neutral point, the energy supplied—neglecting the effect due to the lagging of the currents behind their electro-motive forces—was about 80,000 watts. At the same time there were various apparati at work in Frankfort which absorbed 58,000 watts. These figures give an efficiency of 72 per cent., but it is probable that the real efficiency was 5 per cent. in excess of this amount.

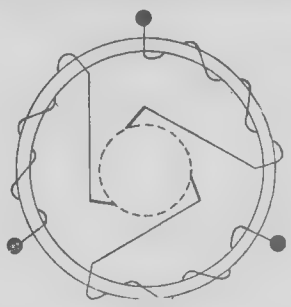


Fig. 27.

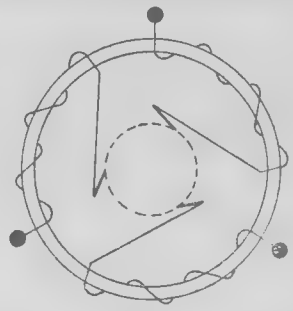


Fig. 28.

The initial expenditure per horse-power amounted to £60, £50 of which was due to the cost of conductors, as might have been expected from the length of the line.

During the whole run of the exhibition there were only three small breakdowns, due in two cases to defective insulators, and in the third case to the breaking of a wire; and the dampness of the weather did not seem to materially affect the insulation of the line.

Herr Dolivo-Dobrowolsky has given a further development to the construction of three-phase machinery. This improvement has been effected by multiplying the number of currents by proper arrangement of the connections without increasing the number of leads. This multiplication of the exciting coils can be applied to the construction of both motors and transformers.

The principle underlying this development will be best understood by considering the simplest case—viz., that in which a separate current is obtained by the combination of two divergent-phase currents, the single current being intermediate in phase to, and greater than, the two component currents.

In Fig. 22 the full lines represent the sine curves of two currents differing by 90° in phase, whilst the dotted curve represents in amplitude and phase the resultant current obtained when the two currents are combined. The amplitude of the resultant current will be, in this instance, 1·4 times that of either of its components.

This increased strength of current may be mathematically proved as follows :—

Let C represent the value of the resultant current, and c_1 and c_2 the values of the component currents :—

$$\text{Then } C = c_1 + c_2$$

$$= c_0 \sin. x + c_0 \sin.\left(x + \frac{\pi}{2}\right)$$

$$= c_0\, 2 \sin.\frac{2x + \frac{\pi}{2}}{2} \cos.\frac{-\frac{\pi}{2}}{2}$$

$$= c_0\, 2 \cos. 45° \sin.\left(x + \frac{\pi}{4}\right)$$

$$= 1{\cdot}4\, c_0 \sin.\left(x + \frac{\pi}{4}\right)$$

Mr. Schallenberger, as early as 1888, in America, proposed to generate and utilise two such currents for feeding motors and transformers, and to employ three leads, one of which served as a return. The motors or transformers could be fed either by each of the alternating currents or by the resultant current obtained by their combination; so that Herr Dolivo-Dobrowolsky was not the first to suggest the use of a current obtained from a combination of two others.

Figs. 23 and 24 are diagrams illustrating the application of the principle to a ring, and Fig. 25 to a transformer of the "interlocked" type.

Fig. 23 shows a ring provided with three pairs of coils connected together at three points. The currents flowing from these points will be intermediate in phase to their components, and greater in magnitude, this being shown by the thicker lines. Fig. 24 shows a similar ring, but provided with three additional pairs of coils, shown in thick lines, which are supplied with currents from the three points referred to with respect to the last figure. This method of connection can be applied to any number of coils, and the theoretical decrease in the fluctuation of the magnetic field due to the coils will be proportionately less.

The advantage obtaining from an increased number of suitably disposed divergent currents is comparable in two respects to the advantage of using in continuous-current dynamos a large number of commutator bars or coils.

It is well known that with a few commutator bars—two or four, for instance—the fluctuations in the electro-motive force of the current can be decreased by increasing the number of bars. The further analogy is that the expense attending an increase in the number of commutator bars beyond a certain extent is not comparable, in considering the question of the fluctuation of the electro-motive force, to the advantage gained.

The number of turns in the coils in which the component currents are used must be less than the number of turns employed in the other coils in proportion to the greater strength of the currents, as otherwise—since the magnetic intensity is proportionate to the number of ampère turns—there would be fluctuations in the induction such as it is desired to avoid.

Messrs. Siemens and Halske exhibited at the Frankfort Exhibition a small motor which is intended to work at a constant speed with varying loads.

Figs. 26, 27, and 28 are diagrams illustrating the action of the motor.

In this motor a rotary field obtains in both the field and the armature. The field core is provided with three symmetrically-disposed coils. One end of each coil is connected to a brush bearing on the commutator of a Gramme or closed-coil armature, whilst the other ends of the coils are connected to leads supplying three currents differing in phase. The brushes are so fixed to a disc of insulating material that their relative or equi-distant positions remain unaltered. In the position of the brushes shown in the first figure no rotation of the armature will take place, as the magnetic axes of the two rotating fields coincide, but directly the brushes are shifted either to the left (Fig. 27) or to the right (Fig. 28) repulsion between the poles of the two fields takes place, and the armature revolves in those directions at a speed dependent on the angle between the axes of the two fields.

Messrs. Siemens and Halske and the firm of Lahmeyer et Cie., of Aix-la-Chapelle, have devoted considerable attention to the development of divergent-phase machinery.

The foregoing brief account of the development of this class of machinery would not be complete without a short *résumé* of the merits of such motors as compared with ordinary alternate-current motors.

A divergent-phase motor, whether of the two-phase or three-phase type, is self-starting, whilst an ordinary or synchronising alternate-current motor has first to be brought up to synchronising speed before the current can be switched on, and if the load exceeds the normal or the speed decreases so as to be less than synchronising speed the motor will come to a standstill. The question of starting ordinary alternate-current motors is not perhaps of so much importance, as there are several methods by which this may be effected, though the problem assumes more importance in the case of small motors.

The triple-current system has the disadvantage of complicating the leads with a necessary confusion to the lay mind, and, moreover, the three wires must be equally loaded if the full advantages of the system are to be obtained. It is impossible to measure directly the currents and the powers carried by the leads in such a system if only three are used, though this can be done by employing 6 leads at the generating and receiving stations whilst still employing only 3 leads for transmission purposes.

On the contrary, the phase difference used in the two current system entails the use of at least three leads, or one more than the number of currents. The two-current system has therefore no advantage for transmission purposes over its rival the three-current system, and there is also, as we have seen, a greater fluctuation in the intensity of the magnetic field produced by the former. On the other hand, it has been urged by the advocates of the two-current system that since the magnetic fluctuation during the period of a single current is not appreciable in the ordinary alternate-current motor, it will be still less so with the magnetism produced by the two currents.

There is no doubt that with the two-current system there is greater simplicity, both in design and in the leads, and the importance of this, viewed from all points, cannot be gainsaid. MULTI-PHASE.

State of the Skilled Labour Market.

THE following memorandum has been prepared for the "Board of Trade Journal" by the Labour Correspondent to the Board of Trade :—During the month just passed industrial conditions have been less disturbed than in the month preceding. Neither in point of number nor of importance have disputes been so serious, and there has been a falling off in the number recorded from 93 in May to but 59 in June, while the number of persons involved is only about one-third of the previous total. The trades at present furnishing the larger proportion of these stoppages of work are the textile and building trades. In the textile industries fifteen strikes have taken place during the month, but these are not of much importance. The building trades of all branches have been unusually active, and are responsible for twelve strikes, while many movements for increased wages or lessened hours of labour have been arranged without cessation of work. Dock labour and shipbuilding trades are, on the other hand, accountable for six and five strikes respectively, most of which are defensive rather than aggressive in character. There have also been nine among coal miners, and the balance are spread over miscellaneous industries. Twenty-two trade unions have sent in reports to the Board of Trade showing the condition of their several labour markets. Taken by themselves, without qualification, the figures compiled from these returns would appear to indicate some improvement in trade, but a little examination shows that the reduced percentage of unemployed is due to a special cause really affecting only one industry. The total membership of the trade societies making returns is 263,681, of which 13,590 are out of work, which is a percentage of 5·15. Last month the total of unemployed was 15,532, and the percentage 5·9. This diminution in the proportion of unemployed to those in work is, however, entirely due to the fact that the arrangement of the dispute and lock-out in the cotton trade which so injuriously affected last month's returns, has permitted of the return to work of many thousands who were then on the unemployed list. Allowing for this special cause of improvement, there is practically no change in the demand for labour; a few trades have slightly improved, but these are balanced by some that show a falling off. In the corresponding month of last year the proportion of those out of work was 2·86. The shipbuilding, engineering, and general iron and steel trades are those which show most signs of depression, and these industries are of so important a character that their present want of activity is sure to react upon many other branches of production.

Shipbuilding Notes.

Messrs. Murdoch and Murray launched on the 12th inst., from their building yard at Port-Glasgow, a composite screw steamer. The dimensions are:—180ft. by 32ft. by 23ft. deep. Messrs. David Rowan and Son will supply the engines.

The Cork Chamber of Commerce has decided, in view of the wreck of the "City of Chicago," to call upon the Commissioners of Lights to erect on the Old Head of Kinsale the best light and the most powerful fog-signal that can be obtained.

The Grangemouth Dockyard Company launched, on the 12th inst., a handsomely-modelled barquentine from their shipbuilding yard at Grangemouth. The dimensions are:—147ft. by 27ft. by 11ft., 300 tons register, and carries 500 tons on a draught of 10½ft.

The new harbour at Worms will be opened to the mercantile world in the autumn. With the opening of the harbour will be commemorated the fiftieth year of the founding of the Worms Chamber of Commerce, which took place on the 21st September, 1842.

Messrs. R and W. Hawthorn, Leslie and Co. Limited, launched from their Hebburn shipyard, on the 9th inst., a large steel screw steamer, to carry over 6000 tons dead weight, of the following dimensions:—372ft. by 46ft. by 30ft. She is fitted by the builders with triple-expansion engines.

There was launched from the ship-building yard of Messrs. John Readhead and Sons, West Dock, South Shields, on the 13th inst., a steel screw steamer of the following dimensions:—Length, 306ft.; breadth, 41½ft.; depth, 24ft. 4in., moulded. She will be fitted with triple-expansion engines by the builders, having 23, 37½, and 61½in. cylinders of 42in. stroke, working to a pressure of 160lb., and will carry about 4500 tons deadweight.

The double-turret monitor "Thunderer" left Portsmouth on the 15th inst. on a cruise to and from Madeira for a further trial of her ferruled boilers under service conditions, and with the special object of determining the effect of cold air upon the tube plates while cleaning furnaces. The engines are to be worked continuously at four-fifths of their full power under natural draught. The "Thunderer" will remain at Madeira for three days.

Messrs. W. Dobson and Co. launched on the 9th inst., from their shipbuilding yard at Low Walker, a steel screw steamer built for the Goole Steam Shipping Company, Goole. The vessel is 235ft. long, 33ft. beam, and 16½ft. deep. She will be fitted by the Wallsend Slipway and Engineering Company with large triple-expansion engines, having cylinders 19, 32, and 52in. in diameter, by 36in. stroke, steam being supplied by two large single-ended boilers. These engines will be capable of propelling the steamer, when loaded, twelve knots per hour.

The steamship "Pontiac," owned by the Mediterranean and New York Steamship Co., has recently been fitted with new high-pressure boilers, and the compound engines converted into triple-expansion engines, this work being carried out by Messrs. Fawcett, Preston and Co. Limited, Liverpool. The original compound engines had cylinders 32 and 64in diameter and 39in stroke, and these have been replaced by a new high-pressure cylinder 20in. diameter, a new intermediate pressure cylinder 34in. diameter, and the low-pressure cylinder fitted with liner, reducing its diameter to 56in. The main boilers, two in number, are 13ft. 3in. diameter and 9ft. 6in. long, constructed for a working pressure of 180lb. per sq. in. At the trial trip the engines worked very smoothly and satisfactorily, developing 13701.H.P. at 78 revolutions, and a speed of 13½ knots was easily maintained.

London Association of Foremen Engineers and Draughtsmen.

THE half-yearly meeting of this association was held in the Cannon-street Hotel, on Saturday, July 2, when the vice-president (Mr. James Brown) occupied the chair. The balance-sheet for the past half-year was submitted and considered to be highly satisfactory. Some general business was then transacted, after which a paper was read by Mr. S. Alfred Varley, on "Energy and Inertia, and their Relationship to Dynamo-electric Apparatus."

Mr. Varley remarked that in dynamo-electric studies we were confronted with the two principles of energy and inertia in a greater degree than in any other study, and the more capable we become of grasping a knowledge of those principles the better are we likely to understand the action of the dynamo. He considered all physical arts were reducible to a duality—viz., energy, the elementary property of all force, and inertia, the elementary principle of all matter, as contrasted with the forces associated with, and which enter into, the structure of matter. The function of a machine is to transmit, and when necessary, alter the potential of the energy transmitted; but the dynamo transforms as well as transmits, and dealing as it does directly with the primary principles concerned in all transmission, the dynamo transmits energy more completely than any other machine. The energy developed by a dynamo worked by a steam engine was transmitted originally from the sun to the earth. In the firegrate of the steam engine the energy contained in coal becomes unlocked and transferred to the water in the boiler, which it converts into a high-pressure gas, developing in the cylinders of the engine mechanical energy, which, being brought under the influence of the dynamo, becomes transformed into electrical energy, and in this form it is capable of being transmitted to almost any distance through solid conducting matter. To understand the nature of electrical transmission we are compelled to have recourse to analogy, and what we see in connection with heat distribution by the hot-water system helps us greatly. In a hot-water system, energy in the form of heat enters the system and is distributed by the water inside the pipes, but no water passes into or out of the system; and if we assume electricity to be part of the conductor itself, and that it is capable of setting up motion in it, then we obtain some sort of notion of the way electrical conduction is supposed to occur. What electricity really is it was impossible to say; but the lecturer was strongly of opinion that it is indissolubly associated with the structure of matter, and controls it, having, in fact, a somewhat similar relation to matter that the mind of man has to the human system. Force is always associated with matter, and forms a sort of duality with it, and physicists tell us that the forces are simple modes of motion. In a sense this may be regarded as a truism; but at the same time it is no explanation, and what forces really are is involved in mystery. Inertia is the distinguishing feature of matter, and energy is the distinctive property of force. Inertia strives to maintain the *status quo*; energy endeavours to bring about change. Energy is positive, and inertia is negative, and wherever we have a manifestation of energy we encounter inertia; in fact, they are the complement of one another, and whenever a transformation of energy occurs the immediate cause of such transformation is the inertia, or inactive energy, resisting the active or positive energy.

Mr. Varley showed some interesting experiments with a large magnet, and also illustrated the laws of motion by a model, and concluded an interesting paper by a description of the action of different modes of winding in the construction of dynamos.

Mr. Parker spoke in appreciative terms of the paper, and proposed a vote of thanks to Mr. Varley. This was seconded by Mr. Heath and carried unanimously.

Mr. Varley briefly returned thanks, and mentioned that he had had the honour of discovering the principle of the dynamo-electric machine, and showed a photograph of his original machine which was made in 1866.

THE directors of the Metropolitan Railway propose a dividend for the past half-year at the rate of 3¼ per cent. per annum, carrying forward £8000. The dividend for the first half of 1891 was at the same rate, when £11,672 was carried forward. On the surplus lands stock the dividend will be at the rate of 2½ per cent. per annum, with a bonus of ¼ per cent. per annum, leaving £1300 to be carried over. For the corresponding half of 1891 the dividend was at the rate of 2½ per cent. per annum, but no bonus was paid, a balance of £2711 being carried over.

Petroleum Tank Steamers.

A MEETING of the Institute of Marine Engineers was held in Gresham-street, E.C., on Tuesday, July 12, presided over by Mr. T. W. Wymer, when a paper on "Petroleum Tank Steamers, their Design and Construction," was read by Mr. G. H. Little, ex-editor "Liverpool Journal of Commerce." Reviewing the various questions arising as prefatory to his subject, the author pointed out that at present the various questions arising in connection with the marine carriage of petroleum were exciting a considerable amount of interest and attention, especially in reference to the navigation of the Suez Canal. He contended that the danger had been much increased, owing greatly to bad design and workmanship—inferior, at least, to what is necessary for safety in steamers carrying such a cargo as petroleum. The author went on to say that the oil, after it leaves the wells, is subjected to a moderate heat, to evaporate the most volatile constituents; this, which is then termed "distillate," is shipped in bulk, and taken to factories and refineries; large quantities are thus shipped to French, German, and Austrian ports, from Batoum. Crude oil is also sent from the United States to Europe, but none to Britain, owing to deterrent legislation, which debars this country from an extensive industry. Crude petroleum, whether the crude or "distillate," contains many volatile compounds which evaporate at comparatively low temperature. This invests the petroleum with its risk and danger; the refined oil has a high flash point, and is thus more free from the risk attached to the crude liquid, which has a low flash point. Such, however, is the risk attached to the transit and storage of the crude petroleum, and such disastrous consequences have ensued, when by want of care and attention to details accidents have happened, that at the present time the petroleum tanker is looked upon by dock, harbour, and municipal authorities, and by seamen, as a dangerous object. This, the author of the paper held, there was no need for; if properly designed and constructed the tanker could be made quite safe. Another element was referred to as necessary for the safety of such steamers —*i.e.*, those in charge of them should thoroughly understand their business and the nature of the cargo carried. Reference was made to the useful work done in connection with the development of the oil-carrying trade by the late Professor Jenkins, and Mr. B. Martell, of Lloyd's, and a suggestion was made that the committee of Lloyd's might in their classification of steamers adopt a symbol, and have regulations of a special kind laid down for the guidance of those who were in any way interested in the petroleum trade, so that confidence could be given to the public mind, and the safety of lives and property might be more assured. The conversion of an ordinary cargo steamer into a tanker was held to be undesirable, unless the greatest of care was exercised to see that the vessel was properly adapted for the purpose, and that the special requirements received every attention. Several designs of petroleum steamers were shown, and their good and bad points referred to. The style of landings for the plates and means of making perfect oil-tight joints were dwelt upon, and mention was made that glue and chalk, or glue and paper pulp, formed mixtures for jointing purposes than which none were better adapted. The dangers attached to the electric-light connections were briefly but strongly pointed out, and emphasis was laid on the duty of those who were entrusted with the fittings of such, especially in oil steamers, to see that their fittings were of the most approved kind for such steamers, and that the work was of the best. The paper throughout was listened to with great interest, and the discussion which ensued no less so.

Messrs. W. H. Nortcott, W. J. Craig, R. Leslie, T. Adamson, A. W. Robertson, F. W. Shorey, Capt. Froude, and others took part in the discussion, in the course of which the dangers to traffic in the Suez Canal were alluded to. It was argued that if tankers were allowed to have transit, more stringent regulations than are at present proposed, should rule. The recent explosions and fires which have occurred were remarked upon as quite sufficient grounds to show the extremely dangerous nature of the cargo carried by these steamers. It was urged that the time had not yet come for the public to have that confidence in oil-tank steamers which would give assurance of perfect safety. The remainder of the discussion referred chiefly to construction and design, and various views were advanced as to the best design of steamer, and the most suitable position for the machinery.

Mr. A. W. Robertson advanced the view that the machinery should be placed aft, and the boilers abaft the engine; the difficulty of trim could be overcome by an arrangement of coal bunkers being partly available for water ballast.

Mr. Little replied to the various questions raised, and the proceedings terminated with votes of thanks to the author and chairman, and to the secretary and committee of Gresham College for kindly granting the use of the hall. A proposal was made and remitted to the Council of the Institute that an adjourned discussion be arranged for.

The Marine Boiler, Past and Present.*

SINCE the days of James Watt, now a century ago, there has been a constant cry for more power. The early boiler was very defective in its construction, being made of cast iron, and very often with flat surfaces —the weakest of all forms,—and hooped with hoops like barrels. At that time no danger arose, for the pressure seldom or never exceeded 12 to 15lb. per square inch. Cast iron was abandoned for copper as the material for making boilers, when pressure rose from 15 to 30lb. per square inch. Wrought iron then became the material, on account of its cheapness in comparison with copper, and at the present time steel is the material that is mostly used for boiler construction. When we look back to, say 25 years ago, it becomes almost inconceivable that we should have built our boilers square, or with all kinds of angles or shapes, made to fit into corners, or into the bilge turn of the ship, regardless of the major requirements of strength. The spherical form of boiler which has been in use in the past has given way to the tubular or cylindrical, with tubular furnaces running through them and in them. Marine boilers of the present are nearly all constructed after this fashion. The greatest aim of the present day is to construct a boiler strong to resist, strong to drive, and strong to meet the cry for more power. The cylindrical boiler seems to have been introduced with reluctance, but eventually, as pressure rose from 30lb.—which at that time was considered the maximum pressure, and $\frac{5}{8}$in. plate the maximum thickness—to 60lb. per sq. in. with the compound engine, it still remains a mystery why, in keeping with the strongest form, the cylindrical boiler was not at once brought into use, it being the easiest of all forms to make. Instead of using the cylindrical boiler the square-box boiler was fitted with stays, or the oval or flat-sided boiler was still adopted. Pressure still being on the increase, it then became imperatively necessary to use the cylindrical form. With the introduction of the triple-expansion engine, the pressure, still on the increase, rose from 100lb. to 160lb., and with the quadruple engine to 200lb., which I believe is the highest working pressure of marine boilers of the cylindrical type at the present time. The dawn of high pressure brought more attention to bear upon the construction of boilers. It seems to me that the boiler has been a long-neglected subject, considered beneath the notice of the other branches of the engineering trade. But to-day it receives quite as much consideration, and in many cases more than the engines to which it furnishes the motive power. The boiler is now a subject of legislation, of Government control, classification, insurance, and in its construction is carefully watched, attended in its infancy, and guarded and feared in its old age. From the time the boiler is placed in position on board ship it is surrounded with a destructive substance both inside and outside, which sooner or later will complete its destruction. And amongst the foremost of these must be placed corrosion and incrustation, or scale, of which you see a few samples on the table before you, from $\frac{1}{16}$in. to $1\frac{1}{2}$in. in thickness; you also see on the table pieces of longitudinal stay, 2in. in diameter, honeycombed in small round holes through and through the stay, showing you the effects of some of the destructive substances which the boiler is surrounded with, which, sooner or later, will be the means of its destruction. These, while reducing the strength of the boiler, appear to me the most common cause of explosions, or collapse of furnace crowns. The boiler being a source of power is also a source of weakness, its strength being determined by its weakest parts. In the construction of boilers, if strength alone were to be the requirement, the spherical form would be adopted, because it is the strongest of all forms. Although such boilers have been in use, they have never come into extensive use, because they have not a large amount of heating surface. The cylindrical form is next to the spherical in point of strength, and superior to it in respect of superficial area or heating surface; hence the reason this form is generally adopted. Apart from the grand distinction of the low pressure and the high pressure of the present time, it has been the means of introducing steel as a material for the construction of marine boilers. It cannot be denied that steel has now taken the place of iron, not only in the construction of boilers, but also in shipbuilding, bridge and all kinds of girder work. A few years ago, when steel was first introduced for the construction of boilers, owing to the unreliable quality of the material manufactured at that time, and in many cases to the manner in which it was treated by the workmen, who had been accustomed to the working of iron, the feeling that prevailed against its use was, in some cases, due to disappointment caused by its introduction to the trade. When the steel plates were of a very hard quality, to such an extent was a high tensile strength aimed at by the makers of steel plates that such have been known to crack right in the centre in a most unaccountable manner; disappointments such as these prevented many from adopting the use of steel at that time. Valuable experiments have been carried out since its first introduction, and experience gained in the working of steel.

There are many methods adopted in the manufacture of steel. The Bessemer and Siemens-Martin processes have now produced a material perfectly reliable as regards its tensile strength, its malleability, and its freedom from laminations and blisters, and which is well suited for the shells of boilers, furnaces, and combustion chambers; but while a material of high qualities, it has been found that its strength becomes seriously impaired by the processes usually adopted in boiler making. Such being the case, it is necessary to use every care in working it to ensure its qualities being retained. The simple process of punching and shearing is said to affect its tensile strength; but the loss can be fully compensated by the simple process of annealing after it has been punched and sheared. It may be as well to remark here —at the same time I have no doubt you all know—that annealing steel plates or bars is done simply by heating them to a low red heat, taking care not to overheat the steel, and cooling uniformly. Steel with a tensile strength of 26 to 28 tons per square inch is found to weld better and with more certainty than steel of a higher strength. The milder the steel the less likely is it to get injured in the working. Steel riveting is a question that has been discussed since its introduction, and the results of experiments made in the Clyde and Tyne districts are that they can be used with as much reliability as steel plate, the tensile strength of the steel from which they are made not exceeding 26 tons per square inch. And it is strongly recommended that they should be heated uniformly throughout their entire length, and not as in the usual way of heating the iron rivet —the point made much hotter than the head of the rivet. By this uniform heating of the steel rivet it will be found to be more easily riveted and much easier to be cut out when required. It seems to me that the day of manual labour in boiler making is a thing of the past. There is now no dishing or flanging of plates done with the wooden mallet or the sledge-hammer; the old system of hand-plating and hand-riveting in boiler construction seems to me to be a thing of the past. They have been superseded by machinery, which flanges steel plates 1in. thick with ease, hot or cold, up to a 10in. flange and the hydraulic riveters readily knock down $1\frac{1}{4}$in. and $1\frac{3}{8}$in. rivets. There is one recent improvement in the hydraulic riveter which I think is worthy of notice. They can be fitted—in nearly all cases where shell and plate riveting must be closed before riveting—with two ramheads, one for the cup-die, the other surrounding and pressing the plates together before the rivet is knocked down. This method prevents a collar being formed round the rivet between the plates. $\frac{3}{8}$in. plate has now gradually increased to $1\frac{3}{8}$in., which, I believe, is the greatest thickness used for boiler shell plating, and at the present time it is considered not practical to use a greater thickness of steel plate for boiler-shell plating.

The real theory of the steam engine and boiler has not yet been explained, and under such circumstances it is not surprising to hear differences of opinion relating not only to the form of boiler best adapted to supply the greatest quantity of steam with the least expenditure of fuel, but also as to its size and the material from which it has to be made. Hand-plating and riveting, as I have already said, has been superseded by machinery. I know of double-ended boilers, with three combustion chambers and six furnaces in each boiler, where all the plating and riveting has been done by machinery, except round the three furnace fronts at one end of the boiler, which had to be hand-riveted. These were constructed in the following manner:—At one end of the boiler the flange of the end plate is facing the inside of the boiler, and joins with the end of the shell plate; the other end plate is facing outwards, and meets the shell plate at the other end of the boiler. By this arrangement all the shell and end plates are riveted by the hydraulic riveter. At one end of the boiler the flanges of three furnace fronts are facing outward, the other three furnace fronts facing inward, these being done by hand-riveting—the only part of the boiler that is hand-riveted. The combustion chamber, top, sides, and bottom plate are flanged towards the inside of the boiler, the back tube plate is plain, while the bottom of the furnace plate is flanged to meet the bottom of the combustion chamber plate. In this case all the riveting is done by hydraulic power, showing that hand-riveting is almost a thing of the past in the construction of the marine boiler.

(To be continued.)

* Paper by Mr. G. Williamson, read before the London Foremen Boilermakers' Association.

Trade Notes.

Messrs. Workman, Clark and Co., of Belfast, are fitting the Allan Liner "Polynesian" with triple-expansion engines.

A proposal is under the consideration of the Leith Dock Commission to light the docks by electricity, the estimated cost of the installation being £10,000.

The directors of Bell's Asbestos Company Limited have declared an interim dividend of 2s. 6d. per share for the six months ending the 30th June.

Messrs. P. and W. Maclellan Limited have received an order for 600 covered goods steel wagons for the Bengal and North-Western Railway Company of India.

Messrs. Blakey, Emmott and Co., Halifax, have secured the contract to supply a switchboard for the Glasgow Corporation Electric Works. The contract price is £1130.

Messrs. Ernest Scott and Mountain, of Newcastle-upon-Tyne, are fitting up an installation of the electric light on the works of the Glasgow Iron and Steel Company at Wishaw, N.B.

The General Electric Power and Traction Company Limited, London, have received instructions from the War Office to erect a 5-ton electric travelling crane at Woolwich Arsenal.

The Pintsch Patent Lighting Company Limited have contracted with the Midland Railway Company to supply them with three oil-gas plants, together with fittings for 886 carriages.

Messrs. Holmes and King, of Liverpool, have secured the contract for building bridges and other works for the London and North-Western Railway Company at Delph, Yorkshire, on the Leeds and Liverpool line.

Messrs. John Shearer and Son, ship-builders, Kelvinhaugh, have received an order from the owners of the Gem Line of steamers to construct a steel screw steamer. The dimensions are 165ft. by 26ft. by 12ft. 3in. She is to be fitted with triple-expansion engines.

The West's Gas Improvement Company Limited, of Miles Platting, Manchester, have obtained the contract for the construction of a wrought-iron tubular water condenser, for the Huddersfield Gas Committee, to be erected in an existing overhead tank at the Leeds-road Works.

A dividend at the rate of 3¾ per cent. per annum is recommended by the directors of the London, Brighton and South Coast Railway for the past six months, as against 3¾ per cent. per annum for the first half of 1891, leaving £13,000 to be carried forward, as against £29,782.

The Birmingham Central Tramways Co. have just placed an order for 600 Epstein cells with the Midlands branch of Messrs. Woodhouse and Rawson United Limited, at the Minories, Birmingham, the cells being for use upon their important electric-car route in that city.

Messrs. R. and D Shankland, Greenock, have contracted with Messrs. Barclay and Curle, shipbuilders, Glasgow, for two steel four-masted sailing ships of 2500 tons register each, and 4200 tons deadweight. They are for the Burns Australian Line, and to be delivered this year.

Wheel cutter in metal only. Every description of gearing. R. CHIDLAW, 43, City-road, Manchester.

Modern tools, standard quality, are the cheapest. Apply Britannia Tool Factory, Colchester, and 100, Houndsditch, London.

Having regard to the enormous circulation of THE MECHANICAL WORLD, the Editor suggests that it is by far the best medium for the insertion of every kind of "Wanted" advertisement, and the price is only one halfpenny per word. The Editor will be glad if MECHANICAL WORLD readers will kindly bear this in mind as occasion arises.

THE AGRICULTURAL SHOW AT WARWICK.—III.

OIL AND GAS ENGINE EXHIBITS.

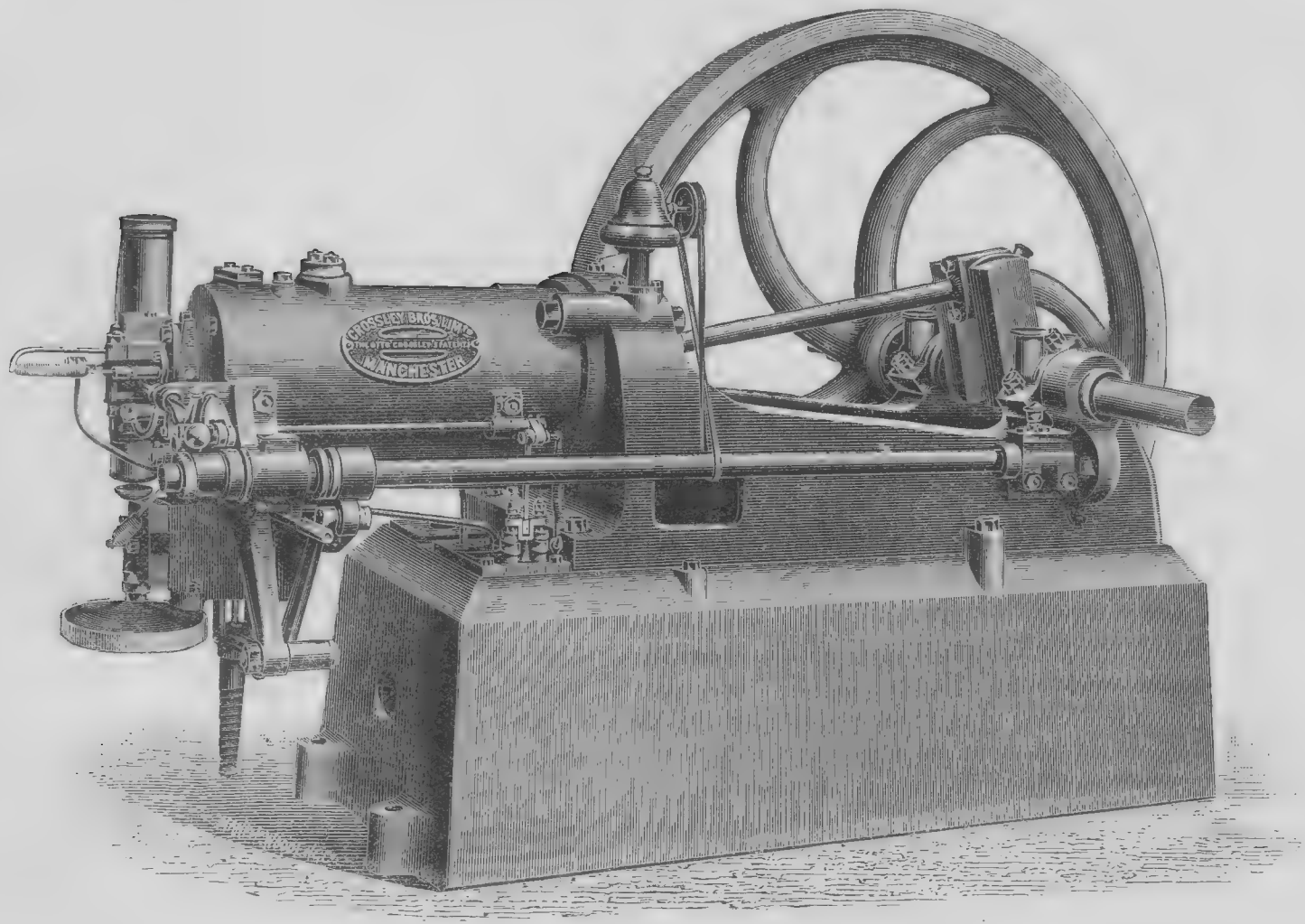


Fig. 1.—Messrs. Crossley Bros.' Oil Engine.

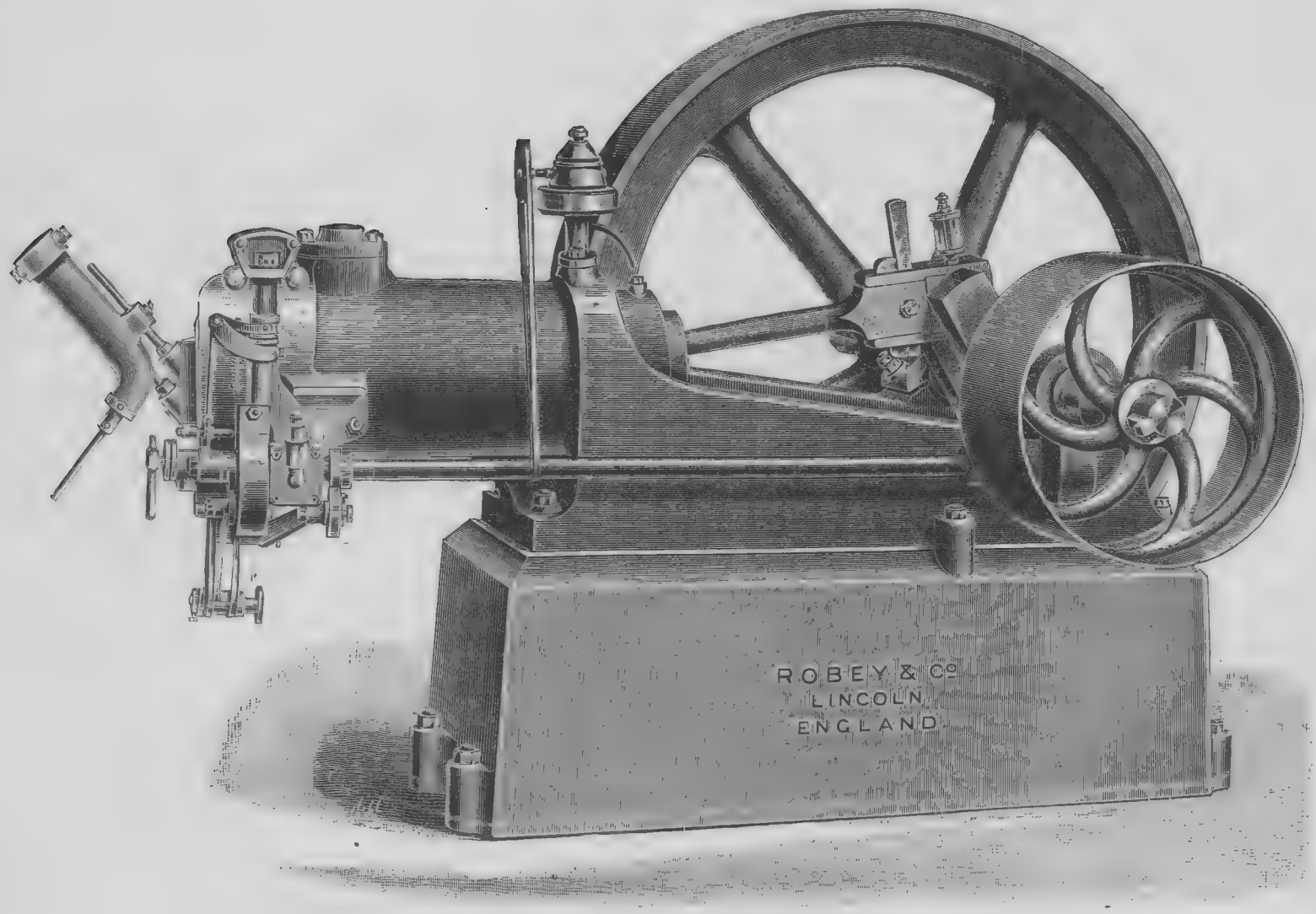


Fig. 2.—Messrs. Robey and Co.'s Gas Engine.

The Agricultural Show at Warwick.—III.

MESSRS. CROSSLEY BROTHERS, of Openshaw, exhibited some half-dozen gas engines of various powers; but much interest was also taken in the oil engines shown, one of which, of 9H.P., is illustrated in Fig. 1. As will be seen, these oil engines bear a marked resemblance to the well-known "Otto" gas engines in external appearance; and as far as the general design and workmanship is concerned, they fully sustain Messrs. Crossley's high reputation. The oil, which has a flashing point as high as 120°, is injected into a vaporiser attached to the back of the cylinder, and forming also an ignition tube to the heater in the same casting. Air is supplied by a pump, and regulated in pressure by means of a circular chamber and indiarubber diaphragm, shown under the back of the cylinder in the illustration on the opposite page. The base of the engine forms an oil tank, from which the oil is pumped by the small pump shown. The oil supply is regulated by the action of the governor, which allows suction to occur when required by the usual hit-or-miss device.

Messrs. Robey and Co., Lincoln, also exhibited several gas and oil engines, of which illustrations are given herewith, Fig. 2 being a gas engine which is made in sizes varying from 7½ to 14½ effective H.P., and in a slightly different form up to 74H.P. The engine has a special form of combustion chamber, by which shock is avoided and a pure charge of gas and air in the igniter is ensured, irrespective of the latter forming a convenient means for carrying the axle for the hind travelling wheels. The oil pumped from this tank is forced against an internal vaporiser, where it is instantly converted into vapour mixed with a due proportion of atmospheric air, and exploded. It is claimed that as the rise of pressure through the working stroke is gradual, violent shock is avoided. A simple and efficient lamp without wick of any kind is provided, and also a fan of special design, by which the internal vaporiser can be raised to the proper heat for starting the engine in a few minutes. It will be seen from the illustration that the engine resembles in appearance an ordinary portable steam engine, and thus can be readily transported on country roads or on a farm, as occasion requires. The oil used can be the ordinary crude petroleum, which is said not to cost more than ½d. per brake H.P. per hour. The refined lamp oils are not required, but can of course be used if the crude oil is not available.

Messrs. Fielding and Platt, of Gloucester, exhibited their "Fielding" gas engine (Fig. 5), which they claim has fewer working parts than any other gas engine. The motor works on the "Otto" cycle, and has no slide or ignition valve, and only one valve under pressure. The guaranteed gas consumption is from 17 to 25cub. ft. per I.H.P. per hour, according to the size of engine and quality of gas used.

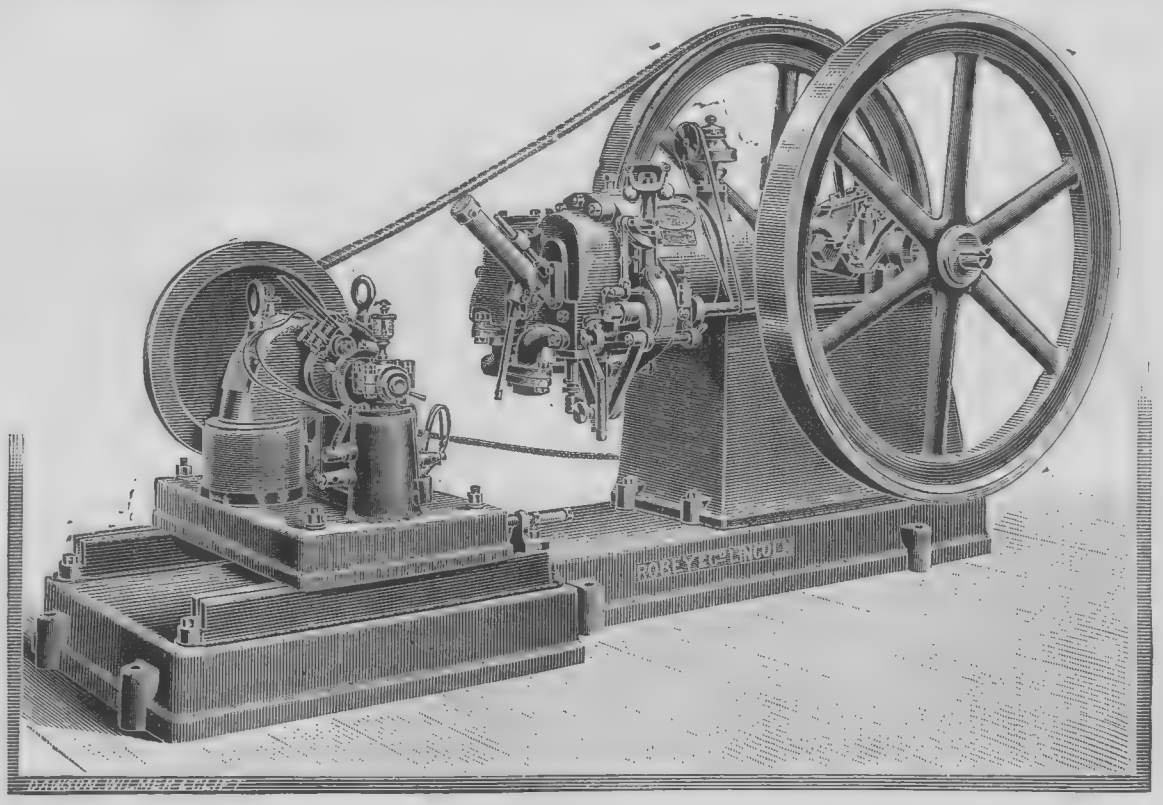


FIG. 3.—COMBINED "ROBEY" GAS ENGINE AND DYNAMO.

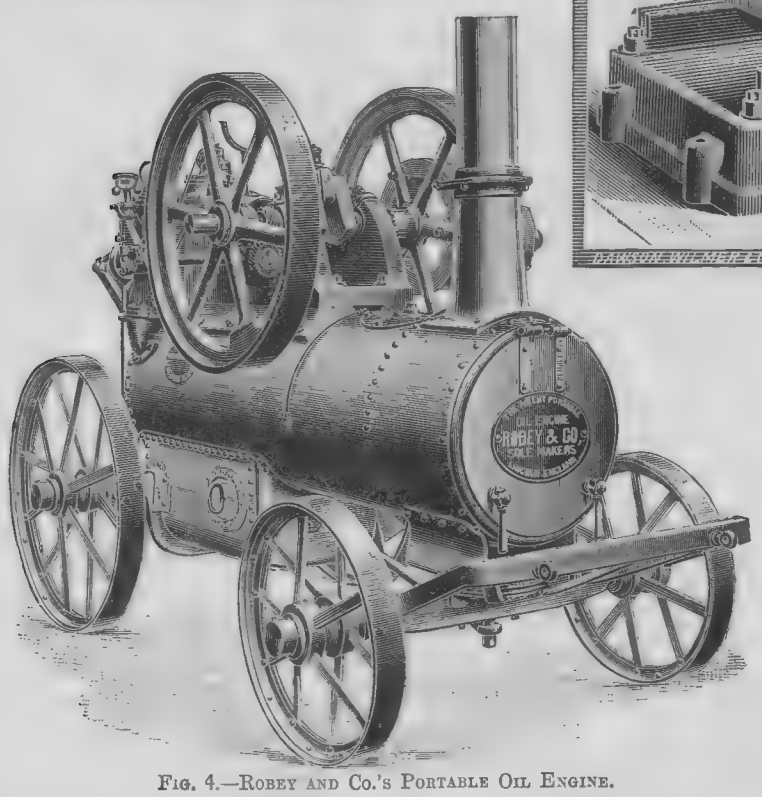


FIG. 4.—ROBEY AND CO.'S PORTABLE OIL ENGINE.

amount of power being given off. An important point in the "Robey" gas engine is that the direction of rotation can be changed in a few seconds. We need scarcely point out the value of this feature, especially where space is limited, as cross belts may be dispensed with, and the engine coupled up to existing shafting. The igniting arrangement admits of the timing being regulated to suit high and low speeds; and as the governor ensures close regulation, the engine is eminently fitted for driving dynamos and other machinery direct. Fig. 3 represents a "B" type of gas engine and dynamo mounted upon one base—a very convenient arrangement for electric-lighting purposes. The difficulty ordinarily experienced in starting gas engines, especially with the larger sizes, has been met in the "Robey" engine by the addition of the makers' double-acting pressure starter, which, while quite free from danger, is very effective in starting the engine. This attachment is fitted to all engines of 30H.P. and upwards.

A novelty, in the form of a portable oil engine, was also exhibited by Messrs. Robey, and is shown in Fig. 4. The engine works on the "Otto" cycle, and is mounted on a steel cylindrical tank, which contains the water required for cooling the cylinder, and around which the water is forced by a circulating pump. A fore carriage and travelling wheels are placed under one end of this circulating tank, while a chamber containing a week's supply of oil is riveted under the other end of the water tank, the

Anti-fouling Paints.

IN September last we recorded in our columns the results of some anti-fouling paint trials, then being carried out upon H.M.S. "Orontes," at Portsmouth. These experiments extended over a period of some 20 months, the final competitors being Col. Crease, the Hartman-Rahtjen Co., and Tugot Frères, of Paris. We then had occasion to mention that in consequence of the remarkably successful results obtained by the French composition it was ordered to be applied to the bottom of H.M.S. "Camperdown"—first-class ironclad of 11,000 tons displacement,—side by side with the Rahtjen paint only. This vessel was dry-docked at Portsmouth on the 5th inst., when it was at once apparent that the French composition was very efficient. The Admiralty authorities have therefore ordered Tugot's composition to be applied to the whole vessel in question.

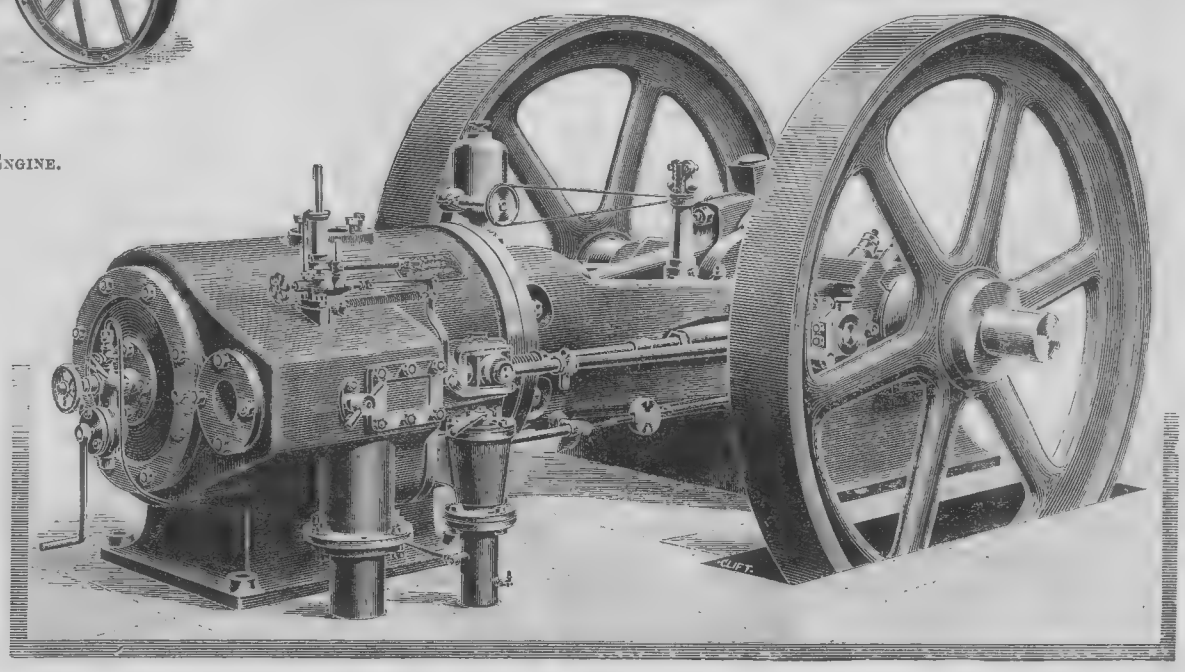


FIG. 5.—THE "FIELDING" GAS ENGINE.

ON the 14th inst., Mr. James Salkeld Robinson, J.P., died at his residence, Woodfield, Rochdale. The deceased gentleman was the head of the noted firm of woodworking machine makers, whose extensive works are situated in Fishwick-street, Rochdale. Mr. Robinson had only attained his 43rd year.

Using a Steel Square.

EVERY man does not know that he can draw a circle with a steel square, two nails and a pencil. If a 6in. circle be desired, and no compasses are at hand, it becomes a question of monkeying with a piece of string and a nail, or the driving of two nails three inches apart through a piece of thin wood, so that the nail points may serve as improvised trammels for drawing the required circle. All this is avoided by the use of the square as a pair of dividers. To draw a 6in. circle, drive two nails exactly 6in. apart into the board on which the circle is to be described. Let the nails above mentioned represent the diameter of the circle, and they must therefore be exactly 6in. apart from outside to outside. Lay a square outside the nails so that the blade will rest upon one, and the tongue of the square touch the other nail. Place a lead pencil in the corner where blade and tongue join. Revolve the square entirely round the nails, the corner holding the pencil approaching in turn first one and then the other nail. After the square has been passed entirely around the nails a perfect circle will be found described upon the board into which the nails were driven.

The reason for a circle being described in this manner depends upon the old geometric proposition that an angle within a semi-circle is always a right angle. To put the proposition into plain English, it means that, if a circle be described and a diameter drawn, then lines from any point in the circumference of the semi-circle touching the ends of the diameter, the angle formed between said lines will be a right angle or "exactly square."

Putting the above into practice, if a carpenter desires to find the centre of any circle, he need only to place the square thereon in such a manner that the corner of the square will just touch the circumference of the semi-circle. Draw lines along the edge of both blade and tongue, and at the point where these lines intersect the circumference of the circle a line may be drawn through the circle joining these points. The line thus drawn through will be the true diameter of the circle. This diameter may be measured and its centre thus obtained, or the square may be revolved part way round the circle, the operation repeated and another diameter obtained, crossing the first one. The point where the two diameters intersect will be the centre of the circle.

There are several mechanical problems that may be solved by the aid of the square, and about as good an illustration as there is is as follows :—

If a mechanic wishes to take two branch pipes from a main pipe of unknown diameter, and the main pipe is to be exactly the same capacity of both the smaller pipes, he can solve the problem very easily with a steel square. If one pipe is 3in. in diameter and the other pipe 5in., the main pipe to have the same capacity equalling the sum of the other two will probably be somewhere between 5 and 6in. in diameter. To solve this problem with a square, take the diameter of one pipe on the blade, and the diameter of the other pipe on the tongue, and the distances are 3in. and 5in. respectively. With a rule or another square, measure across from one mark to the other. The distance thus found will be the diameter of the large pipe. By arithmetic the diameter will be found by adding the squares of 5 and 3, and then extracting the square root of the sum.

If there be three pipes to branch from one, the size of the two may be found as above, then the distance taken on one side of the square, the diameter of the third pipe taken on the other side, and a new diagonal measured, which will be the sum of the three diameters. This matter applies equally as well to squares as to circles ; it also applies to right angles and other shapes having like angles, or sides in proportion to each other.

Every mechanic has not caught the idea of laying off angles with a steel square, says Mr. J. T. Hobart in the "Industrial American." If an angle of 45° or the "true mitre" is required, it is pretty easy to find it by laying a square upon a straight line with equal figures on both blade and tongue just touching the line. For instance, place the square upon the edge of a straight board so that the 12in. marks are just even with the edge of the board. A line drawn along either blade or tongue of the square will be at an angle of 45° with the edge of the board. To draw an angle of 60° use the whole length of the blade, 24in., and 13in. on the tongue. When in this position a line drawn along the blade of the square will form an angle of 30° with the edge of the board, and a line drawn beside the tongue of the square will show an angle of 60°. Other angles may be studied out, provided the mechanic knows a little of the rudiments of geometry.

Building stair stringers and rafters is where the steel square is seen at its best. Probably the first time a mechanic had occasion to lay out a stair stringer or rafter for a building he employed all the ingenuity, mathematics, and cuss words he knew of. The latter do not add to the accuracy of a man's work, but they do seem, in some instances, to prevent a severe attack of brain fever, to say the least.

After a mechanic has learned all about the steel square, he will be able to lay out stair stringers, rafters and hip roofs without trouble or profanity. If a stair stringer has 10ft. run and 8ft. rise, it is comparatively easy to lay a square upon a piece of board so that the figures 8 and 10 touch the edge of the board. Draw a line on the side of the square upon and through the 8in. mark ; then draw the square back, keeping it exactly upon this line until the figure 6 comes even with the edge of the board. The other side of the square will now mark a little less than 8in., and a line can be drawn upon this side also ; then a piece of board, being a little less than 8 × 6in., may be carefully cut out and used as a pattern for laying out the stair stringers.

A strip of board nailed upon the diagonal edge of this pattern will enable it to be placed upon the edge of the stair stringer, and marks may be made on each side of the pattern for the purpose of sawing out for riser and tread respectively. As each step is to be 6in. high, and the elevation is 8ft., there must be twice as many steps as the elevation is feet high ; therefore, the flight of stairs will have 16 steps. Mark off 16 lengths on the pattern on the edge of the stringer ; then saw off from the bottom of the lower step an amount equal to the thickness of the thread to be placed upon the stringer. From the back side of the top step cut off a piece equal to the thickness of the riser, and the stringer will be finished.

The same method can be employed when laying out the rafters for a house. If a house 40ft. wide is to have a roof with a rise of 13½ft., one of the rafters will represent the hypotenuse of a right-angled triangle having 20ft. base and 13½ft. perpendicular. The cuts from the foot and top of the rafter may be obtained by taking 20in. on the blade and 13½in. on the tongue of the square, and applying these points to the edge of the rafter, marking along the blade of the square for the foot, and along the tongue of the square for the top. Next draw the blade of the square along upon the mark made beside it in precisely the same manner described for cutting stair stringers, until the 12in. mark comes even with the edge of the rafter. Mark at this point where the tongue comes even with the edge. Then move the square along so that 12 on the blade comes to the mark thus made beside the tongue. Repeat this movement twenty times, which is one-half of the number of feet in the width of the building. The twentieth mark made by the tongue of the square will represent the length of the rafter and the cut by which the top is to be sawn.

For quick and easy work it pays to prepare two thin strips of wood so that they may be screwed together and adjusted to the square to represent the diagonal of any measurement which may be used on the blade and tongue. When strips of this kind are used it is much easier to adjust the square in making the twenty measurements above mentioned. There is not so much chance for error in figuring the size of pulleys. It is sometimes necessary to increase or decrease the speed of a shaft a few revolutions. To get just the size of pulley necessary for this increase or reduction of speed requires close calculation when figures are used, but a square will do it off-hand and correctly every time. For instance, it has been ascertained that a pulley 20in. in diameter on a certain shaft will give a speed of 13 revolutions per second. If it be desired to reduce the speed to 11½ revolutions per second the 20in. pulley must be removed and one of different size substituted.

To solve this problem with a steel square take 20in. on the tongue and 13in. on the blade. Place both of the marks on the edge of a straight board and draw a line parallel with the blade. Move the square parallel with this line until the tongue shows 11½in. instead of 13in. Notice the reading on the blade and edge of the board. This reading will be the size of pulley required in place of the 20in. concern to give the desired speed of 11½ revolutions per second. The principles involved in the calculations here made have been amplified and put into a more convenient shape for everyday use.

In this perfected form some mechanics are familiar with the tool, but all do not recognise it in the slide rule. The principle upon which all slide rules work is that of the square and the piece of board above mentioned.

Metal Trade Memoranda.

The Whitecross Company, of Glasgow, has secured an order for 100 fathoms of wire rope for the Clyde Trustees.

The directors of Messrs. Brown, Bayley's Steel Works Company recommend a dividend of 15s. per share for the half-year ended June 30.

The Finnieston Engineering Company, 169, Finnieston-street, Glasgow, has acquired the goodwill, stock, and assets of the Iron and Steel Fencing and Buildings Company, as a going concern.

Germany imported from Great Britain during the month of June 13,569cwt. of wrought, and 224cwt. of unwrought copper, as compared with 10,930cwt. and 2924cwt. respectively in June, 1891.

It is stated that there are 352 furnaces in blast throughout the United Kingdom at the present time, as compared with 386 at this time last year. The figures for the North-east of England for the same periods are 76 and 89 respectively—a decrease at present of 13 furnaces.

The English Crown Spelter Company Limited, whose smelting works are situated in Swansea, held their ninth ordinary general meeting in London, on the 12th inst. In 1890 the net profit was £12,300. The result of working in 1891 was a net profit of £15,080 19s. 11d., and an interim dividend of 2½ per cent. for 1891 had been paid. It was now recommended that a further dividend of 5 per cent. be declared, which would leave £1280 19s. 11d. to be carried forward to next account.

The iron ore resources of Ontario, Canada, seem likely to be developed soon, and it is reported that capitalists have in hand a project for the erection of blast furnaces near Toronto, and are urging the provincial government to grant financial aid. It is proposed to erect furnaces with a capacity of smelting 100 to 150 tons of pig iron daily. The ore is said to be of superior quality and low in phosphorus. It is proposed to use coke for fuel. The government is asked to pay a bonus of 2dols. per ton for all ore mined, and it is thought that, as this will help to develop the iron-mining industry of the country, the request will be granted.

The amalgamation of the interests of the firms of Carnegie Brothers and Co. (Carnegie, Phipps and Co.), the Allegheny Bessemer Steel Co., and the Keystone Bridge Co., which is just announced from New York, has been the means of constituting what is believed to be the largest iron and steel manufacturing concern in the world. The plant owned by the new coalition comprises two separate blast-furnace installations, including the famous Edgar-Thomson furnaces, with a total annual capacity of 1,025,000 tons of pig iron ; seven finished iron and steel constructive works capable of turning out per year 1,267,000 tons of products, in addition to 700,000 kegs of wire nails ; two coke works, and one iron mine. It is estimated that the syndicate, which has been registered under the title of the Carnegie Steel Co. Limited, of Pittsburg, will employ from 25,000 to 30,000 hands—at least it is calculated it will do so when the present disputes between the Messrs. Carnegie and their workmen are finally settled.

It appears from official returns just issued that the exportation of tin plates and sheets for June shows a material shrinkage compared with the corresponding month in 1890 and 1891. The statistics thus furnished are as follow :—

Destination.	Tonnage.	Value. £
Russia	2,697	34,781
Germany	336	4,528
Holland	276	4,174
France	583	7,858
United States	23,550	311,912
Australasia	469	6,483
British North America	1,671	26,255
Other countries	4,459	63,102

The total tonnage for June, 1892, was 34,041, of the value of £459,093, compared with 71,310 tons and £1,163,733 for the corresponding period of 1891, and was 39,370 and £580,326 in June, 1890. The greatest falling off was in the exports to the United States, whence 63,539 tons of tin plates were sent in 1891 and 30,793 tons in 1890, compared with 23,550 tons last month. The totals for the six months ended 30th June were 206,777 tons, of the value of £2,824,042, compared with 306,206 tons and £5,111,316 in 1891, and 190,860 tons and £2,906,993 in 1890.

The Metal Market.

PRICES CURRENT.

LONDON, July 18.

COPPER was 2s. 6d. better during early trading, due to support from American operators, but the advance was lost in the afternoon consequent upon increased stocks, and the tone was barely steady after the official close, with values at Friday's level. Three months sold from £45 5s. to £45 2s. 6d., while cash, after business at £44 15s., declined to £44 13s. 9d. sellers, and late August was finally done at £44 16s. 3d. Sales, 525 tons. Settlement price, £44 12s. 6d. English tough, £47 10s. Best selected, £48 10s. Strong sheets, £57. Messrs. H. R. Merton and Co. give the Chili charters for the fortnight ending July 15 at 1200 tons. Messrs. James and Shakspeare give the receipts during the first half of the month in England and France at 6527 tons, with deliveries 4257 tons, thus showing an increase of stocks of 2270 tons, and making the total visible supply 53,874 tons against 56,604 tons on July 1, and 57,664 tons on July 16 last year.

TIN gained about 5s. on initial business in response to the higher prices from New York, but when the limited demand had been met values drooped and ruled easy to the close, which was unchanged from Friday's final rates. Mid October and mid September made £97, and cash was sold from £97 2s. 6d. to £97. Sales, 50 tons. Settlement price, £97. English ingots, £97 10s. The shipments of Straits for the first half of July was officially cabled as 1225 tons, of which 725 tons were for England, 410 tons for America, and 90 tons for the Continent. The deliveries from London warehouse over the same period have been 462 tons, and warehouse stocks are now 1697 tons, against 1553 tons at the beginning of the month.

PIG IRON has been inactive, but bidding for Scotch showed improvement, and closed ½d. above Friday's prices, the market otherwise showing no change. Settlement prices :—Scotch, 41s. 4d. ; Middlesbrough, 40s. 3d. ; hematite, 49s. 6d.

TINPLATES are steady. I.C. cokes, f.o.b. London, 13s. ; Liverpool, 12s. 6d. ; Swansea, 12s. 3d.

LEAD has been quiet, and at the close values were easier, the nearest price for Spanish being £10 10s. ; English, £10 15s. to £10 17s 6d.

SPELTER has shown a hardening market, and closes fully 2s. 6d better. Ordinary, £21 12s. 6d., buyers ; £21 15s., sellers, July-August. Silesian specials, £22.

ZINC.—Silesian sheets are weak, and 5s. lower ; ordinary, £24 ex ship. Belgian dull ; V.M. brands also being 5s. down at £24 ex ship, and £23 15s. export.

OFFICIAL CLOSING QUOTATIONS.

	£	s.	d.	£	s.	d.
COPPER—						
G. M. B.—Cash	44	13	9	45	1	3
„ Three months	45	3	9	45	11	3
English tough	—	—		—	—	
Best selected	—	—		—	—	
Strong sheets	—	—		—	—	
TIN—						
Fine foreign, cash	97	0	0	97	10	0
„ Three months	96	15	0	97	5	0
Australian, cash	97	5	0	97	15	0
PIG IRON—					s.	d.
Scotch warrants—Cash					41	4
„ One month					41	6½
Middlesbrough—Cash					40	3
„ One month					—	
Hematite—Cash					49	6
„ One month					—	

Trade Marks.

The following is the Official List of Applications published from July 6 to July 13, for the Registration of Trade Marks, so far as relates to the Metal Trades.

CLASS 5.

THE IBEX

160,607. Goods included in Class 5, being galvanised sheets and hoops. BURNELL AND CO., 4, Tabley-street, Liverpool ; galvanised iron manufacturers.—21st November, 1891.

CLASS 5.

163,633. Unwrought and partly wrought metals used in manufacture—namely, rough, pig, ingot, hoop, wire, bar, rail, bolt, sheet, or plate iron, lead, copper, zinc, tin, bismuth, and antimony, but not including steel. WILSON, LATHAM AND CO., 34, King-street West, Manchester ; merchants.—24th March, 1892.

CLASS 6.

164,878. Envelope-making machines and all kinds of machinery and parts of machinery included in Class 6, excepting weighing machines, scales, salting machines, sausage chopping and sausage mincing machines. LOTZ, ABBOTT AND CO., 66, Queen-street, Cannon-street, London ; merchants and factors.—18th May, 1892.

The Official Gazette.

Partnerships Dissolved.

J. AIRD and W. LOCKIER, under the style of Aird and Anderson, Liverpool, tool manufacturers.

R. W. ANDREWS and SYDNEY L. HARLOCK, under the style of Andrews and Harlock, Gray's Inn-road, W.C., brewers' engineers, coppersmiths, etc.

THE BANKRUPTCY ACTS, 1883 AND 1890.

Receiving Order.

WILLIAM HESKETH, Hulme, Manchester, ironfounder.

Commercial Gazette.

☞ The name given is that of the defendant ; the amount is that for which judgment was given, and the date is that on which it was given.

County Court Judgments.

WELCH, BRADSHAW AND CO., Great Western Docks, Plymouth, engineers, £20 1s. 8d. 16th June.

THE BIRMINGHAM METAL STAMPING COMPANY, 50, Pontonville-road, N., £12 9s. 16th June.

New Companies.

UNITED STATES INVENTORS' INSTITUTE LIMITED.—This company was registered on the 12th inst., with a capital of £2000, in £1 shares, to obtain, apply for, take out, acquire, buy, sell, work, develop, and deal in patents of all kinds, and to act as agents, representatives, correspondents, and attorneys of merchants and traders in any part of the world. The number of directors is not to be less than two nor more than five, the first to be appointed by the signatories ; remuneration to be fixed at the ordinary general meeting. Registered by George Tucker and Co. Limited, 97, Cheapside, E.C.

STEAM USERS PATENTS COMPANY LIMITED. This company was registered on the 7th inst. with a capital of £5000, in £5 shares, to manufacture, sell, and deal in steam traps, lubricators, steam generators, boilers, boiler tubes, etc., and to enter into an agreement with Mr. J. R. Rhodes. The number of directors is not to be

less than three nor more than seven, the first being Messrs. J. R. Rhodes (managing directors), W. H. Peacock, F. Milne, and Sarah W. Rhodes; qualification, £100; remuneration, £120 per annum, divisible. Registered office, 8, King street, Manchester.

ELECTRICAL COMPANY LIMITED.—This company was registered on the 13th inst., with a capital of £15,000, in £5 shares, to acquire and take over the business, assets, and liabilities of Key's Electrical Company Limited, to enter into the agreement mentioned in clause 3 of the articles, and to carry on the business of electrical and mechanical engineers, suppliers of electricity, and manufacturers of electrical apparatus. The number of directors is not to be less than two nor more than five, the first being Messrs. Franz and Felix Deutsch; remuneration, 10 per cent. of the net profits available for dividend. Registered by Messrs. Michael Abrahams, Sons and Co., 8, Old Jewry, E.C.

J. C. HOWELL LIMITED.—This company was registered on the 9th inst., with a capital of £25,000, in £5 shares, to acquire, take over as a going concern, and carry on the business of electric light engineer, carried on by Mr. J. C. Howell, at New Dock, Llanelly, and 24, Queen Victoria-street, E.C. The number of directors is not to be less than three nor more than seven, the first being Messrs. J. C. Howell and W. M. Meredith, who are to be managing directors for five years; remuneration, J. C. Howell £800 per annum, W. M. Meredith £300 per annum, to be raised by £50 in each year till it reaches £800 per annum. Registered by Messrs. Deacon and Co., 4, St. Mary Axe, E.C.

ECONOMIC STEAM PRODUCER SYNDICATE LIMITED.—This company was registered on the 8th inst., with a capital of £25,000, in £1 shares, to adopt an agreement to be made between Messrs. J. E Bott, J. Higson, W. W. Creeser, R. A. Gartside, J. G. Sington, G. H. Cammell, and C. D. W. Cammell of the one part, and Mr. J. Bott (for the company) of the other part, and to carry on the business of iron-founders, mechanical and electrical engineers, manufacturers of agricultural machinery, tool makers, brassfounders, etc. The number of directors is not to be less than three, nor more than seven; qualification, £250; remuneration as the company in general meeting determine. Registered by Messrs. Pritchard, Englefield and Co., Painter's Hall, E.C.

CORNWALL BOILER COMPANY LIMITED.—This company was registered on the 8th inst., with a capital of £16,000, in £20 shares, to acquire and carry on the business of boiler makers, boiler inspectors, engineers, etc., carried on by Messrs. J. H. and J. M. Holman, at Carn Brea, Cornwall, and with a view thereto to enter into and carry into effect the agreement referred to in clause 3 of the articles (dated July 6, 1892, between the said Messrs. J. H. and J. M. Holman of the one part, and Mr. F. Andrews, for the company, of the other part). The number of directors is not to be less than three, nor more than five; qualification, £400; remuneration, £50 each per annum. Registered by Messrs. Robbins, Billing and Co., Surrey House, Victoria Embankment, W.C.

CENTRAL RAIL TRACTION COMPANY LIMITED.—This company was registered on the 13th inst., with a capital of £10,000, in £10 shares, to adopt an agreement dated June 20, 1892, between Messrs. F. Purdon, H. E. Walters, B. Mott, P. O'Donnell, E. H. Woods, W. H. Woodcock, Sir J. Kitson, J. H. Kitson, T. P. Reay, and A. G. Evans of the one part, and J. C. Hart (for the company) of the other part, for the acquisition of Patents Nos. 13,351 and 13,352, for improvements in the permanent way of railways and for improvements in connection with rolling stock for railways, and to develop and turn to account the said patents. The number of directors is not to be less than three, nor more than seven; the first being Messrs. A. G. Evans, F. Purdon, and E. H. Woods; qualification, 25 shares; remuneration, £350 per annum, divisible. Registered by Messrs. Burchell and Co., solicitors, 5, The Sanctuary, Westminster, S.W.

JAMES SIMPSON AND CO. LIMITED.—This company was registered on the 11th inst., with a capital of £250,000, in £10 shares, to acquire the undertaking, property, and assets of James Simpson and Co. Limited (registered on December 19, 1885), to undertake and discharge the liabilities and engagements of that company, and to carry on at the Engine Works, Grosvenor-road, Pimlico, and elsewhere, the business of manufacturing engineers, mechanical engineers, machine and engineering tool makers, boiler makers, iron and brass founders, millwrights, and metal workers. The number of directors is not to be less than three, nor more than seven; qualification, 100 shares; remuneration to be fixed by the company in general meeting. Registered by Messrs. Batten and Co., solicitors, 32, Great George-street, S.W.

LITHANODE AND GENERAL ELECTRIC COMPANY LIMITED.—This company was registered on the 8th inst., with a capital of £100,000, in £1 shares, to enter into and carry into effect an agreement to be made between the Mining and General Electric Lamp Company Limited and its liquidator of the one part, and this company of the other part, and to carry on the business of electricians, mechanical engineers, gas engineers, lamp manufacturers, manufacturing chemists, contractors for public and private works, suppliers of electricity, etc. The number of directors is not to be less than three nor more than nine, the first to be appointed by the signatories; qualification, £500; remuneration, £100 each per annum, an extra £50 for the chairman, and 10 per cent. of all profits of the company in any year after 15 per cent. has been paid. Registered by Messrs. Pain, Son and Pollock, 14, St. Helens-place, E.C.

RICHMOND (SURREY) ELECTRIC LIGHT AND POWER COMPANY LIMITED.—This company was registered on the 8th inst., with a capital of £10,000, in £5 shares, to carry out the terms and provisions of the Richmond (Surrey) Electric Lighting Order, 1883, in so far as they may be carried out in accordance with and subject to the provisions of a contract dated December 5, 1891, between the Corporation of the Borough of Richmond of the one part, and Messrs. Latimer Clark, Muirhead and Co. Limited, of the other part, and with a view thereto to enter into the agreement with Messrs. Latimer Clark referred to in clause 3 of the articles, whereby the benefit of the said contract of December 8, 1891, is to be assigned to the company. The number of directors is not to be less than three nor more than ten, the first to be appointed by the signatories; qualification, £200; remuneration, £600 per annum, divided as they themselves determine. Registered by Messrs. Lumley and Lumley, 37, Conduit-street, Bond-street, W.

SYRIA OTTOMAN RAILWAY CO. LIMITED.—This company was registered on the 30th ult., with a capital of £600,000, in £20 shares (of which £5000 are 7 per cent. preference), to carry out and give effect to an agreement dated June 2, 1892, between Mr. G. H. Phillips (for the company) of the first part, Mr. W. Pickup of the second part, and Messrs. J. R. Pilling, H. H. Bolton, G. E. Whitworth, W. E. Whitworth, and W. Parker of the third part; to enter into an agreement with Messrs. Pauling and Co. for the construction of the company's railway; to conduct, work, maintain, manage, and control a fully-equipped line of railway running from Akka and Haifa, on the Mediterranean coast, to the city of Damascus, in Syria, fully licensed for passengers and goods traffic by the Ottoman Imperial Government; to acquire possession of and right to the share certificates and shares of the railway company known as "La Société du Chemin de fer Ottoman de la Syrie," and to construct piers, docks, or harbour works at Akka and Haifa. The board of directors shall consist of not less than five nor more than nine members, the first being Messrs. J. R. Pilling, Colonel O. O. Walker, H. H Bolton, W. E. Whitworth, and W. Parker; qualification, £1000; remuneration, £250 each per annum. Registered by Messrs. Parker and Ayre, 5, Norfolk-street, Manchester.

Letters to the Editor.

*** *We do not hold ourselves responsible for opinions expressed by correspondents.*

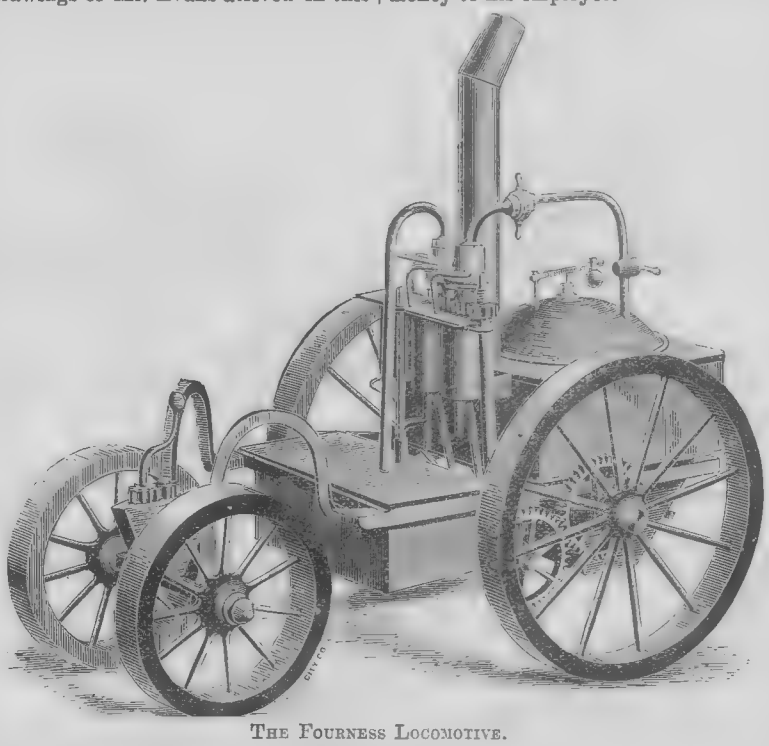
*** *The name and address of the writer (not necessarily for publication) must in all cases accompany letters intended for insertion, or containing queries.*

*** *Letters intended for publication in the current week's issue must reach our Manchester Office not later than by the first post on the Tuesday preceding the date of publication.*

OLIVER EVANS AND THE LOCOMOTIVE.

To the Editor of THE MECHANICAL WORLD.

SIR,—In your issue of the 8th of July I notice that you have a leaderette relative to the first locomotive, which is claimed for Mr. O. Evans, of America. Enclosed please find woodcut of a locomotive that was patented Nov. 6, 1788, eight years before the drawings of Mr. Evans arrived in this



THE FOURNESS LOCOMOTIVE.

country. The Fourness locomotive did not require water for condensing purposes, and was constructed with three cylinders and two hollow plug valves, one for letting steam into the cylinders and the other for letting it out. The exhaust steam then passed to a cistern containing water for feeding the boiler. The water in the cistern became heated, and was then pumped into the boiler. The pump rod was attached to one of the piston rods. This engine would work without a flywheel, and was made for drawing one or more carriages, to be attached thereto by bolts, chains, swivels, or other couplings. The boiler was provided with a safety valve. Only one of the rear wheels was keyed to the main axle, so as to allow the engine to turn corners readily. It may be noted that a crank or winch is shown in the drawing for the purpose of turning, by means of the pinions, the forecarriage, and in the specification the use of "chains and other implements in place of the tooth and pinion" is claimed.

A somewhat similar engine was patented, in March 4 of the same year, for "a new invented machine for working, towing, expediting, and facilitating the voyage of ships, sloops, barges, and other vessels upon the water, whereby the conveyance of goods will be rendered more certain as to time upon the water." The specification describes a method of varying the position of the paddle shaft to suit the burden of the vessel.

H. FOURNESS.

Manchester, July 11.

DEVIATIONS FROM THE DRAWINGS IN THE WORKSHOP.

To the Editor of THE MECHANICAL WORLD.

SIR,—As a practical mechanical draughtsman, and one who has read the article and correspondence on the above subject in your valuable paper, will you kindly allow me to make my own practice public?

It is not my intention to criticise, but merely to give the results of my experience.

To begin with, a draughtsman should study the character of the manager, head draughtsman, and of each foreman, and, knowing the nature of each, "work with the grain." He should consult the foreman pattern-maker as to new patterns and alterations; the foreman turner or machineman about turned or machined work; the manager about anything which may require his attention.

If all this is carried out well the foremen will see that the draughtsman wishes to assist him, and not to dictate to him on subjects which, perhaps, even a first-class draughtsman knows very little about. Of course, a foreman does not wish to be troubled with every small detail, which would occupy too much time.

When a draughtsman is thus working hand in hand with the foremen, he will find that each of them will let him know about any alterations that have been made in the shop (these, however, will be few and far between), and a good draughtsman will find time to make a note on the drawing and the shop tracing, of the alteration.

Thus, in this way, a first-class draughtsman may improve his own knowledge, get his work done accurately and pleasantly, saving his own time and temper, as well as money to his employer.

I have made a point of following this out to the letter; and I believe I have only had trouble with one foreman turner. When I found out that he was making alterations without my knowledge, I at once told him, as pleasantly as possible, that I wished to work along with him, and hoped he would assist me as far as he could. After this I never had any trouble.

Some managers and foremen are very unwilling to look at a drawing before it is finished; but a little persuasion and explanation usually overcomes this obstacle. I trust this may be of some little use to your readers.

ALL ROUND.

Lincoln, July 16.

PRICE LISTS.

To the Editor of THE MECHANICAL WORLD.

SIR,—In your notice of our catalogue in THE MECHANICAL WORLD of July 15, you refer to it as a "price list . . . which contains no prices." We would remind you, however, that *there are price columns*, which, when the catalogue is sent out to customers, *are duly filled in*; but as you were not looked upon as a customer we of course left them blank. In following this method of procedure we only do what (on account of the market fluctuations, and for other purposes understood in the trade) is done by most of the other large lubricant firms.

R. SMURTHWAITE, JUN., *Secretary*
(For the GLYKOLINE LUBRICANT CO. LTD.).

Middlesbrough, July 18.

Miscellaneous Items.

The docks at La Charente, France, are to be lighted by electricity.

The survey for the cable between San Francisco and the Sandwich Islands has been completed. The length from Hilo is 2060 miles.

The Ward Electrical Cart Company, London, have constructed a new electric cart, which will shortly be used in the streets. They are also constructing a number of electric omnibuses.

The Great Eastern Railway Company state that the accounts for the past half-year show net receipts sufficient, after providing for rents, interest, and dividends on all the guaranteed and preference stocks, for the payment of a dividend on the ordinary stock at the rate of ¾ per cent. per annum, carrying forward a balance of about £5000. For the corresponding period the dividend was at the rate of 1½ per cent., and £4172 was then carried forward.

The new harbour works at Dover are to be commenced next week, the conditions under which the contract for £400,000 was accepted last week being that the work should commence within 14 days. The construction of the eastern arm is expected to take six years, during which it is estimated that £20,000 a year will be spent on labour alone, as all the concrete blocks will be made at Dover. After the construction of the eastern arm, a breakwater will be built, and the harbour will then accommodate the largest liners afloat.

There were shipped from Tyne Dock during the week ended July 9, 146,500 tons of coal and coke. This is an increase of 23,600 tons on the quantity of the corresponding week of last year, and it is the best week's shipment from any dock known. The shipments average 1000 tons per hour of the six working days of twenty-four hours, which shows good work and efficiency of dock management. Considering the privations which dock labourers had to undergo owing to the Durham strike, the healthy demand is a blessing to them.

The official returns of the London Electric Railway show that during the year just ended each of the 13 locomotives travelled 27,000 miles, while on the Metropolitan District Railway the average for the steam locomotive is 20,000 miles. The cost of working is equally satisfactory. The cost of locomotives and generating power, including wages, repairs, and renewals, was less than 8d. per mile. The weight of the train is 42 tons, exclusive of the passengers, which is considerably more than the electric engines were designed to draw, so that the results are very satisfactory.

The Edison General Electric Company, New York, have put on the market an automatic switch for use with electrically-operated pumps employed in filling water tanks. This is a simple single-pole switch with ebonite base, mounted upon an angle piece and operated by a ball float. As the water rises in the tank, the ball float rises with it until it reaches a point where the switch is opened by the operation of a spring. The motor consequently stops, and no more water is pumped into a tank. As the water is drawn off, the ball falls with the water lever, the switch is closed, the pump starts and continues working until the tank is again filled to the desired point. The ball and all parts coming into contact with the water are insulated from the switch connections and line terminal, so that no part of the circuit can be grounded through the tank. Switches of this type can be used in connection with motors up to 2 kilowatts capacity, and can be arranged to operate upon any reasonable change in water level.

The influence on the evaporative power of a boiler of warm air supplied for combustion has recently been again tested in Germany, and the results are given in the "Chemiker Zeitung." Two sets of tests were made, one with cold air taken from a courtyard through wooden ducts and supplied to the furnace, and the other with air which had been warmed in suitable heating chambers. The number of lbs. of water evaporated per lb. of coal were found to be—

With warm air ..... 7·77 and 8·70
With cold air ..... 7·33 and 8·09

showing for the warm air a gain in evaporative power of from 6 to 7½ per cent. The temperature of the warmed air ranged from about 120° to 123° F., and that of the cold air from about 68° to 75°.

The publisher of "The Mechanical World" will send a prepaid parcel of specimen copies to anyone, in any part of the world, who can distribute them advantageously amongst his engineering friends. Business card or bill-head should be enclosed as a guarantee of good faith, and number of copies stated.—Address: 391, Strand, London, or New Bridge-street, Strangeways, Manchester.

Queries.

☞ Readers are invited to avail themselves of this section for practical information on questions relating to Mechanical Engineering and the Scientific Industries.

☞ Queries and Replies should arrive at the Manchester Office not later than by the first post on the Tuesday preceding the date of publication.

MAKERS OF CELLULOID.—Required the names and addresses of extensive makers of celluloid.—B. P.

NICKEL.—In an alloy of cast iron and nickel what is the increase in strength over cast iron, and what proportion of nickel should be used?—T. C.

ALUMINIUM.—Will any reader inform me what is the greatest percentage of metal alumina has been found to contain up to the present date?—ALUMINA.

ECONOMISER SCRAPERS.—What means must I adopt to renew some broken scrapers in the middle of the range of pipes in the economisers?—PUZZLED.

PATTERNMAKER'S TOOL BOX.—Will any reader give me a sketch of the patternmaker's tool box, with full dimensions and particulars?—APPRENTICE.

CRUCIBLE.—Will any reader inform me how plumbago crucibles are made for melting brass and steel; also sketch of machine for making same.—PLUMB.

RIFLING MACHINE.—I should be glad of a sketch of any appliance used for rifling out small barrels, such as revolvers, etc., say ¼in. to ⅝in. bore, with threads, say, 6in. pitch.—NEMO.

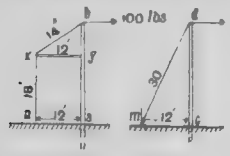
FRICTION OF WATER IN PIPES.—What is the head of water in feet necessary to overcome the friction of a bend 10in. bore and 12in. radius; velocity of water, 170ft per minute?—VULCAN.

FEED-WATER HEATER.—Could anyone kindly give the square feet of heating surface for a 6in. feed-water heater, or the best allowance per I.H.P. of engine? What is the usual amount in a first-class heater, say Atkinson's or Berryman's?—P. H. S.

HOT-AIR ENGINE.—Will some reader of THE MECHANICAL WORLD kindly oblige me with a section and principal dimensions of a ¼H.P. single-acting hot-air engine of the Stirling cycle?—GEO. H. PERKINS, North Queensland.

HEAD-GEAR FOR COLLIERY.—I have contracted to make a pitch pine head-gear for a colliery. The pitch pine is 16in. square, and the head-gear is to be 35ft. high; also, it has to be placed on either brick or stone pillars 15ft. high. Can anyone inform me of a good plan to get it to the top of these pillars, or will someone kindly show me how I am to get it into position?—ALPHA.

STAYING TELEGRAPH POSTS.—*a b* and *c d* are two telegraph posts of equal height, firmly fixed into the ground. How can *m d* be



proved to be a stronger way of staying than *n x b*? Also, what is the compressing thrust on the strut *x y*, and the bending moment about *y*?—TELEGRAPH POST.

WATER FLOWING INTO JET CONDENSER.—Will some fellow-reader kindly give me a worked-out example of the quantity of water that will flow through a 4in. pipe 30ft. long, with four bends, into a jet condenser with 18in., 24in., and 28in. of vacuum; wheel valve wide open, giving same area as pipe; also with it half open? The water supply tank is 8ft. below condenser. The condenser is working on a set of triple-expansion engines. What effect have bends and temperature on supply water?—SUGAR MILL, North Queensland.

LOCOMOTIVE CONSTRUCTION.—Will any correspondent enlighten me as to the mode adopted in locomotive work in order to fix the position of the axles (horizontally) so that each axle may have a pre-determined portion of the total weight resting upon it? Say:—

Load on leading axle	.....	0·32
„ driving „	.....	0·48
„ trailing „	.....	0·20
		1·00

Of course, I am aware there are certain circumstances—such as length of barrel, position of firebox, etc.—which in practice to a great extent influence this, but the point I wish clearing up is: Given the total weight, how are the positions of axles determined so that the pre-arranged weights rest on them? An answer would be of service to others as well as to—HILLSLAND.

Replies.

☞ Owing to the constant increase in our correspondence we regret that we have no alternative but to announce that we cannot reply by post to Queries even when stamped envelopes are sent.

☞ Queries and Replies must in all cases be accompanied by the names and addresses of the writers, as no notice will be taken of anonymous communications.

PATENT.—We do not know of the firm you name.

D. C. W.—Yes; it would be best to do as you suggest.

G. G. P.—The smaller boiler is much the stronger of the two.

J. BOWLING.—Try Messrs. Armstrong, Stevens and Son, Birmingham.

W. MALVILL.—The electrolytic method of separation, as practised by the Metal Reduction Syndicate, Patricroft.

H. BIRKBY.—We should not advise you to buy a catechism. Read Ripper's "Steam" (2s. 6d.), to be had from our office.

J. GASCOYNE.—The manager of our patents department will be pleased to give an opinion on the subject you name at a cost of 10s. 6d.

W. CRITCHLEY.—We cannot refer you to any recent comparative trials of turbines. We do not think that you will be able to obtain the required information.

MODERN.—We are unable to refer you to a table such as you require, but will prepare one for insertion in the "Mechanical World Pocket Diary" for 1893.

CARDIX.—Your best plan will be to consult a trades directory; we cannot be continually giving names when it is so easy for you to help yourself in the manner indicated.

A CONSTANT READER.—It is impossible to give an exact reply to your query, and an approximate one would be valueless. We would advise you to communicate with Messrs. Holden and Brooke, St. Simon's Works, Salford.

C. B. C.—There are no relations between the factors, as you suggest. Of course the number of revolutions made by an engine of given dimensions and working with a certain steam pressure will depend upon the load or if running light upon the friction of the engine.

R. A. HOUSTON.—You would keep steam more easily with the additional boiler, and no doubt your steam would be drier, thus tending to economy. But you would certainly use more coal with two boiler furnaces to supply. Could you not increase your boiler pressure or improve the working condition of your engine?

FITTER.—First remove grease by boiling the castings in a strong solution of boiling soda lye, and then dip them in a mixture of 100 parts by weight of nitric acid, 50 parts of sulphuric acid, one of soot, and one of common salt. When the castings show a bright appearance rinse them quickly in a large quantity of water, which must be frequently changed.

MECHANIC (Newcastle.)—Both the articles you name are, we should judge from the description you give, worth patenting, but the course you suggest would be fatal to your interests, as the ideas could easily be appropriated by the people you send to. Your best course would be to protect the inventions. The manager of our patents department will be pleased to assist you on your writing to him.

CONICAL TANK.—A tank in the form of a conical frustum is made 12in. deep, to hold 13 ale gallons when full; the diameters are to be in the proportion of 5 to 3. Will any reader give a rule or formula to find the diameter?—MECHANIC.—*A.*—In reply to "Mechanic," the formula for obtaining the contents of a conical or flaring vessel is:—

$$\text{Contents in ale gallons} = \frac{H \times (D^2 + d^2 + Dd) \times 0{\cdot}2618}{277{\cdot}27}$$

where H = perpendicular height in inches, D and *d* top and bottom diameters in inches. Let us now substitute K for the term D^2+d^2+Dd, and we have

$$\text{Contents} = \frac{H \times K \times 0{\cdot}2618}{277{\cdot}27} = H \times K \times 0{\cdot}000944.$$

$$\text{Whence } K = \frac{\text{Contents}}{H \times 0{\cdot}000944}.$$

Substituting now the known quantities, we have

$$K = \frac{13}{12 \times 0{\cdot}000944} = 1147.$$

The value of D^2+d^2+Dd must, therefore, be 1147, and the only combinations of diameters which will produce this sum are 27×11 and 22×17, for $27^2+11^2+(27\times11)=1147$, and also $22^2+17^2+(22\times17)=1147$. From these your querist will have to choose, as no diameters approaching the ratio he names will form a vessel of 12in. height to hold 13 gallons.—WM. COX.

Latest Inventions.

APPLICATIONS FOR LETTERS PATENT.

When Patents have been "communicated," the name of the communicating party is printed in italics.

Where complete specification accompanies application, an asterisk is suffixed.

4th July, 1892.

12,337 STEAM MOTORS. P E Jacomy and L V Biget.

12,341 APPARATUS for INDICATING the POSITION of SIGNALS on RAILWAYS. H Clapham.

12,343 EXTRACTING COPPER, GOLD, and SILVER from ORES. J Nicholas.

12,362 SUSPENDED TRAMWAYS. E W Hughes and L Campbell.

12,366 PUMPING ENGINES.* American Elevator Company. (*Otis Brothers and Co.*, United States.)

12,373 SELF-PROPELLING PORTABLE ENGINE. J Lutz and J C van den Arend.

12,375 ROLLER MILLS for GRINDING, CRUSHING, or BREAKING GRAIN. A Stevenson.

12,380 TRAIN SIGNALLING APPARATUS. J S H Pellat.

12,381 PLATES for STORAGE BATTERIES or ACCUMULATORS. E B Bright and M Bailey.

12,385 APPARATUS for STIRRING and DRAWING the CHARGE of GAS RETORTS.* W Foulis.

12,387 OXYGEN GAS. A V Newton. (*A Noble*, France.)

12,388 MORTISING MACHINES for CUTTING or PUNCHING HOLES INTO WOOD. J Phillips.

12,396 LIGHTING of RAILWAY TRAINS ELECTRICALLY. I A Timmis.

5th July, 1892.

12,397 REGULATION of the POTENTIAL DIFFERENCE of ELECTRICAL CONDUCTORS. J Sayers.

12,399 VERTICAL-ROLL METAL BENDING and ROLLING MILLS. A J Pardon and A Laing.

12,401 STEAM BOILERS.* E F Edgar.

12,403 ENGINEER'S OIL CAN. W Child and P Kendrick.

12,408 MOTIVE-POWER MECHANISM. G L Place.

12,421 DECOMPOSITION of MINERAL OILS for the PRODUCTION of ILLUMINATING GAS. W Young and A Bell.

12,423 TANDEM GAS or OIL MOTOR ENGINES. F W Crossley.

12,424 TUBULAR BOILERS. J Imray. (*G Strickland*, Malta.)

12,428 COUPLING for RAILWAY CARRIAGES. W H Parkes.

12,436 ELECTRIC INSULATORS.* H H Lake. (*L McCarthy*, United States.)

12,438 PULVERISING MACHINES.* H H Lake. (*U Cummings*, United States.)

12,442 LIGHTING and HEATING of RAILWAY VEHICLES by ELECTRICITY.* L D Adler and others.

12,444 HOT AIR ENGINES. H Michaux and A Gray.

12,449 OIL, SPIRIT, or GAS ENGINE. W Pullen and R Briggs.

12,458 SHIFTING BELTS from THEIR PULLEYS. J Forest and H Poret.

12,459 GENERATING STEAM for the PROPULSION of ROAD VEHICLES. J K Starley.

6th July, 1892.

12,468 ELECTRICITY METERS. J Edmondson and J Oulton.

12,473 METAL TUBES. G Hatton.

12,474 SAFETY ARC LAMP. R Drysdale.

12,479 FLUID-PRESSURE REDUCING VALVES. A Prentice.

12,482 APPARATUS for USE in ROLLING TUBES and HOLLOW ARTICLES. E Cope and A Hollings.

12,491 TREATING RICH ARGENTIFEROUS BLENDE. J David.

12,492 EXTRACTING SILVER from ORES CONTAINING the SAME. J David.

12,493 GRINDING or CRUSHING MILLS. T W Brittain.

12,494 BEARINGS for REVOLVING and OSCILLATING SHAFTS. W Gould.

12,497 GAS ENGINES or MOTORS. J E Burr and M Donne.

12,498 STEAM BOILERS. H Schomburg.

12,499 ROLLING MILLS HAVING THREE SUPERPOSED ROLLS.* A Thomas.

12,503 WINCHES. J Temperley.

12,505 APPARATUS for TONGUING, GROOVING, MORTICING, and TENONING and SHAPING WOOD. J Bouillon, fils aîné.

12,506 TELEPHONE TRANSMITTER. R H Jones.

12,507 MACHINE for SAWING METAL. W H Beck. (*C Spofford*, United States.)

12,508 APPARATUS for INDICATING the FLOW of FLUID. H S Maxim.

12,511 ELECTRO-MAGNETIC CLUTCHES. E Willans.

12,516 ILLUMINATING RAILWAY LINES. W E Ferguson.

12,517 MOTIVE POWER MACHINE. L Wake.

7th July, 1892.

12,528 TELEPHONIC APPARATUS and SWITCHES. G L Anders and W Kottgen.

12,540 NEEDLE LUBRICATORS.* W E Heys. (*Schäffer and Budenberg*, Germany.)

12,548 INDICATING on RAILWAY TRAINS the NAMES in ROTATION of the STATIONS THROUGH WHICH SAID TRAINS are PASSING. P A Hale.

12,551 RAILWAY CHAIRS and FASTENINGS R Ames.

12,552 PREVENTING SCALES or INCRUSTATIONS in STEAM BOILERS. G P Gardner.

12,553 UNIVERSAL THERMOMETER.* E Edwards. (*H Hartl*, Austria.)

12,554 EXTRACTION of GOLD and SILVER from ORES. C M Pielsticker.

12,557 CIRCULAR SAWS for CUTTING METALS. A Cook.

12,564 RAIL JOINTS. B Blears.

12,565 TAPS or STOP-COCKS. Evered and Co. Ltd. and T D Gadd.

8th July, 1892.

12,588 DISPLACEMENT PUMPS for AIR or GASES.* J H Hargreaves and J G Hudson.

12,593 PACKING for GLANDS and JOINTS in ENGINES and PUMPS. L Cresswell.

12,594 PACKING for GLANDS and JOINTS in ENGINES and PUMPS. L Cresswell.

12,603 PUMPS. J C Hudson.

12,609 STEAM GENERATORS. J Lyall.

12,616 AUTOMATICALLY SIGNALLING on RAILWAYS. G H Brockbank.

12,618 COMBINATION WALL SOCKET and SWITCH for ELECTRIC CURRENTS. L Schramm and S T Wyand.

12,619 ELECTRIC SWITCH. L Schramm and S T Wyand.

12,625 ROPE CLIP or GRIP for the ROPE HAULAGE of COAL TUBS. R S Williamson.

12,628 PULLEYS.* J W Parkin.

12,637 FIRE BARS. C Jones and R Thomas.

12,641 EXTRACTION of GOLD and SILVER from ORES. J C Montgomerie.

9th July, 1892.

12,655 CONDUITS for ELECTRIC or CABLE-ROADS. P Willis. (*C H Bates and others*, United States.)

12,659 STEAM BOILERS. J Wild.

12,663 SCREW PROPELLERS. J Harper.

12,664 APPARATUS for CHARGING INCLINED GAS RETORTS. The Automatic Coal-gas Retort Company Limited.

12,671 STEAM GENERATORS. J Sutton and J W Buckley.

12,672 APPARATUS for REGULATING the SUPPLY of AIR or STEAM. G L Davies.

12,675 REAMERS or OTHER SIMILAR BORING or CUTTING TOOLS. W T Smith.

Manuscript Specifications of Patents can be examined at the Patent Office, London, after the Complete Specification has been accepted, on payment of 1s. The printed Specifications are usually published in about one month after acceptance of the Complete Specification, and any single copy may be obtained by remitting 8d. in stamps (or by special post cards sold at the Post Offices at 8d. each) to Sir H. READER LACK, Comptroller General, Patent Office, 25, Southampton-buildings, Chancery-lane, London. When a number of Specifications are required, remittances may be made by P.O.O.

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FACTS FOR ADVERTISERS.

A TON AND A HALF OF PAPER is now used every week in the production of THE MECHANICAL WORLD, three-quarters of a ton being despatched to the London Office (391, Strand) for distribution throughout the Metropolis, and the Southern and Home Counties and abroad, by the London wholesale newsagents. The other three-quarters of a ton are similarly distributed throughout the Midland and Northern Counties, Scotland, and Wales.

☞ THE MECHANICAL WORLD *is published every Friday at 391, Strand, London, and at New Bridge Street, Manchester. It is particularly requested that business communications from the Provinces be addressed to the Offices at New Bridge Street, Manchester, and London communications to 391, Strand. Letters referring to Editorial matters should in every instance be sent to the Manchester Office.*

FRIDAY, JULY 29TH, 1892.

The Jarman System at Work.

THE opinion has frequently been expressed in this journal that electric tramcars on the storage-battery principle must take a prominent position at some future date on our street lines for urban traffic. Even those who were primarily concerned in making the first experiments with self-contained cars in this country continue to pin their faith to that method, although they for some time past have been remarkably quiet, awaiting future developments. The Jarman system, to which reference has occasionally been made, is now undergoing practical tests at Croydon. As far as speed is concerned, our experience of the cars equipped on this particular system is that they are capable of more than meeting the requirements of either town or suburban traffic, although in the latter case a higher rate is often run than in the former; a maximum speed of 16 miles an hour actually performed is certainly good work. Since January last two cars on the Jarman system have been in operation at Croydon. These have been run alternately owing to the recharging of the cells, and the difficulties encountered were recently enumerated by the inventor. One of the peculiar features of the gearing was the use of vulcanised fibre teeth in the mortice wheels, they having been adopted to ensure noiseless running. These teeth, however, gave way after a few weeks' running, owing to the car being brought to a stand when travelling at the normal speed of about seven miles an hour, the stoppage being made so as to avoid running over a horse in a dark part of the line at night. This kind of tooth was considered not adapted for everyday work, and teeth made of hard gun metal were therefore substituted. These have since then proved a success. The second difficulty was the breakage of one of the cast-iron mortice wheels, which broke in the main body into four pieces. This type of wheel, it may be mentioned, was adopted only in the first car which had been made for the syndicate. The second car, which was designed and put together by Mr. Jarman, was fitted with wheels cast in phosphor bronze, and having gun-metal teeth working well with wrought-iron pinions. With one exception, which may be disregarded, the compound or double armature motor used has given complete satisfaction, and has well withstood all the strains of every-day work. The storage batteries have, according to the author, fully answered his expectations. Not a single cell has required to be renewed since the cars commenced service, and it is estimated that the cost of traction—fuel, renewal of batteries, wages, repairs, and sundries—comes out at 4¼d. per car mile run. The above general *résumé* of the working of the cars is interesting, and there is no doubt that the publication of details concerning the operation of other storage battery cars would tend to enhance this method of locomotion. As it is, with the exception of the interested circle, very little is known about the difficulties met with and overcome either at Barking or in Birmingham. We may, however, anticipate data on some future occasion.

An Electrical Census Machine.

THE developments in the application of electricity to so many diverse purposes have been so rapid that we have got beyond the stage at which we paused and asked, "What next?" into a state of calm acceptance and belief in the possibilities of any new application that we may be apprised of. Thus it is with one of the latest applications of this mysterious fluid which we hear of—namely, the compilation of population statistics by electrical machinery. It appears from the latest bulletin issued by the Dominion Government of Canada that after the statistics had been collected in the census of 1891 the results were compiled by electrical machines. For the purpose of this compilation every person in Canada registered by the census enumerators has a card upon which is stamped a number corresponding to his or her number in the enumerator's schedule. This is for the purpose of identification. A series of punched holes at the left end of the card indicates the province, the district, and the sub-district to which the person belonged on April 6, 1891. A second series of punched holes scattered over the card indicates the sex, age, occupation, religion, and all other particulars required. A record is thus transferred from the enumerator's schedules to the cards, of all the twenty-five questions asked in schedule No. 1. These cards are then passed through the electrical tabulator, which, by ingenious contrivances, records the answers on a number of dials. For instance, in dealing with religions, the tabulator is adjusted so as to separate the 4,800,000 cards by sub-divisions of electoral districts into the twenty-five different religions which are recognised as of sufficient importance to be tabulated. Each time the circuit-closing device is brought down upon the card the hand of one of the dials moves and a bell rings to tell the operator that the religion has been registered. In many cases several facts may thus be recorded simultaneously. Thus, the second "run" includes the registration of these facts—first, whether the card is that of a French-speaking or an English-speaking Canadian; second, the age, the sex, whether married or widowed, or single; and third, the place of birth of the individual, whether in one of the provinces in Canada, in one of the sub-divisions of the United Kingdom, or in some foreign country. The same movement of the circuit-closing device which registers on the dial these facts also lifts for each card one of a number of lids in a box attached to the instrument, thus indicating the receptacle for that card, so as to separate all the cards according to ages—the children's cards being separated for each year up to five, and the others by five-year periods. It is said that this system of compilation has the merit of absolute accuracy, and that as each individual has a card the tabulation becomes a check upon the counting of the population, and this enables the officials to rectify errors in the previous count and to eliminate duplications which may have escaped the notice of those who made the preliminary count of the people.

Another Safety Device for Oil Tank Steamers.

IN our issue for the 1st inst. we referred at length to a safety device for oil tank steamers, and as evidence of the attention which the problem of the safe carriage of petroleum in bulk is now receiving, we may mention that Mr. B. H. Thwaite, C.E., of Liverpool, has devised an exceedingly simple apparatus for preventing the accumulation of explosive mixtures of oil-gas and air in the tanks. Connected to the tank hold is a pipe of a few inches in diameter that rises 15ft. above the height of the deck, and then by a bend is led on the outside of the vessel some 6ft. maximum below the water level. When a specific pressure has been established in the oil tank the gas freely bubbles through the water, and escapes. On the contraction of the oil in the tank by a fall of temperature, the air is prevented from entering by the water seal due to the hydraulic dip of the gas escape pipe. The device seems to offer a simple and inexpensive solution of the problem, and will doubtless receive due attention.

The Administration of Indian Railways.

THE Director-General of Indian Railways, in his report for the financial year ending June, 1892, which has just been issued by the Government of India, states that 874 miles of line were opened during the year. The total broad-gauge line is now 10,103 miles, mètre gauge 7171 miles, and 288 miles of special gauge. The principal works during the year were the Kistna Bridge, the East Coast Railway, the Madras Railway extensions, the commencement of the Godavery Bridge, and the opening of the Khojak tunnel. The grain and seed traffic was 7¾ million tons, against 5½ millions in the previous year. By far the largest quantity was carried by the North-western Railways, and was shipped from Bombay. The works in progress or sanctioned are 1697 miles, the chief being the Assam-Bengal, the Mu Valley, and the Marri-Attock Railways. Collieries show a steady increase in product, Indian coal having more than doubled since 1880, when it was little over a million tons, but nearly 1¼ million tons of English coal is still imported for Indian railways. Six thousand wagons are reported fit for artillery and stores, and over 7000 are adapted to carry horses, while the fitting of double couplings and interchangeable brake gear has made good progress. In passenger traffic the third-class is over 97 per cent. of the whole, the increase on last year's earnings being about 10 per cent. The goods tonnage has increased 15½ per cent., chiefly in wheat and seeds. Coal receipts rose from 85¼ to 100¾ lakhs last year. The grain returns rose by 177 lakhs, the receipts from jute seven lakhs, from oilseeds 38 lakhs, from salt four lakhs, from sugar three lakhs, while raw cotton receipts are lower by 14¼ lakhs, twist and yarn two lakhs, and liquors half a lakh. The persons employed on railways are just over a quarter of a million natives, 4626 Europeans, and 5936 Eurasians. Europeans show a small falling off, and the Eurasians a slight increase. In all India there were six serious collisions of passenger trains and 23 of passenger and goods. The numbers of killed and injured other than by their own fault were 56 and 135 respectively. Working expenses are 45 per cent. of the gross earnings on the standard gauge, 53 per cent. on the mètre, and 64 per cent. on the narrower gauges. The average return on all lines on capital expenditure is 5¾ per cent., inclusive of 32½ lakhs carried to the sinking fund of the East Indian, Eastern Bengal, and the North-western Railways. The net loss to the State is probably about 38½ lakhs.

Rome Lighted from Tivoli.

THE increased attention given to the subject of the employment or utilisation of existing heads or falls of water during late years is again exemplified by the recently successful lighting of the city of Rome from the Falls of Tivoli, situated at a distance of about 15 miles from the city. Here it appears six turbines of 2000 H.P. have been erected at the base of an enormous tower of masonry, which conceals the cascade, and which is supported by the ancient wall that surrounds the town. These turbines are capable of driving dynamos generating currents ample not only for lighting up the streets and public buildings, but at a small additional cost admitting of being so increased as to provide illumination for private dwellings also. The currents are carried across the Campagna, and transformed into currents of lower pressure at a loss, it is said, of only 20 per cent. of the initial force. The building for receiving the current is situated at the Porta Pia, and on the night when the current was transmitted for the first time this building was magnificently illuminated by arc lights.

Multiple Railway System.

IT will be interesting to learn what is the multiple railway system which is to be a leading feature of the Chicago Exhibition next year. We understand that this method has been placed in Great Britain, where a powerful syndicate has been formed to show its practicability. Colonel Cody and Mr. Nate Salsbury have, we are informed, been instrumental in causing leading English capitalists to become interested in promoting the enterprise. A combination of Paris bankers have viewed with approbation the affair, and propose to introduce the system in France. Mr. Max E. Schmidt, civil engineer of Chicago, who represents the parent company in that city, has just left London, satisfied in having placed this American invention, which, it is said, promises to revolutionise modern methods of locomotion. We hope shortly to hear more of this system, and to see it in operation as soon as a line is equipped.

Amalgamated Society of Engineers.

THE quinquennial conference of the Amalgamated Society of Engineers has now been sitting at Leeds for the past five weeks, and will probably sit for some three weeks longer. Some important decisions have been arrived at. The name of the society has been changed to that of the "International Amalgamated Society of Engineers." Alterations have also been made in the qualification for membership, so that all engineers will be eligible for membership up to 45, paying a graduated scale of contributions. It has been decided to elect a permanent paid council, in the place of the present unpaid volunteer executive committee, which is, of course, confined to London members of the society. The country has been divided into eight electoral districts, each of which will send a member to the council. This body is elected for three years, after which half of its members will retire every eighteen months. Six organising secretaries will be appointed by the members of the society, and will retire triennially, but be eligible for re-election. Resolutions have been passed against piecework, and the district committees have been ordered to do all in their power to discourage it. An important resolution has also been come to, upon the motion of a North-east Coast delegate, that no dispute shall be entered upon without a ballot vote of all the members of the society being first taken, and then only if three-fifths of those voting are in favour of it. Other suggested reforms are under discussion.

Machine Construction.

THE CONSTRUCTION OF MACHINE ELEMENTS.

(*Continued from page* 305, *vol. xi.*)

§ 128.

FORMS FOR IRON COLUMNS.

THE columns which are used in machine construction must be held down to the iron baseplates of the machines, or, if used in connection with building construction, are secured to foundations of masonry. Heavily-loaded columns are often placed upon foundation stones with only a sheet of lead beneath and no fastening; but otherwise some form of anchorage must be used. The illustrations show three forms of fastening. In each case the soleplate is placed beneath the pavement. In the first case a special form of soleplate is held down to the masonry by an anchor bolt; in the second the flange, which is cast on the column, is bolted to the keys shown; the third construction (by Borsig) is arranged with a short cylinder bolted to the faced soleplate and made so as to give a space in which melted lead may be poured after the column is set in its exact position. A hole is left in the side of the column to admit the melted metal. The portion of the base of the column which shows above the pavement is made to conform to the general style of the building. In Fig. 369 a simple moulding is used between the plinth and shaft; in Fig. 370 a bead is added; and in Fig. 371 a double moulding of more elaborate outline is used.

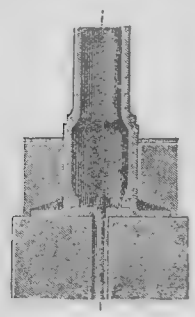


FIG. 369.

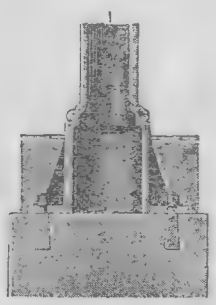


FIG. 370.

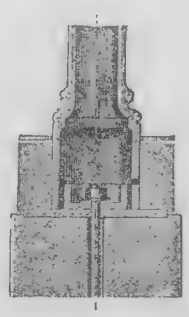


FIG. 371.¶

The capitals of such columns are made in many varied forms. Fig. 372 shows, in section and elevation, a capital arranged to carry a beam and also to support the base of the column of the floor above. A recess in the top of the column receives the main beam, and affords a good place for a joint. If iron beams are used, this recess is made proportionately narrower. The base of the upper column is securely bolted down as shown.*

The capitals of iron columns afford much more opportunity for effective decoration, which in many cases is neglected, although comparatively easy of execution. For the lower columns of heavy buildings the simple cubic capital so often found in Romanesque buildings is most suitable, and a good example is shown in Fig. 373.† A somewhat lighter form is shown in Fig. 374, and for some situations the various Gothic capitals are suitable (Fig. 375). In all three examples the pattern making and moulding are not difficult. The form most used in machine construction is shown in Fig. 376, being something between the Roman Doric and the Tuscan orders, and having an echinus beneath the cap-plate, and an astragal bead around the column a short distance below. By varying the distance of the latter from the former the effect can be modified for taller or shorter columns.

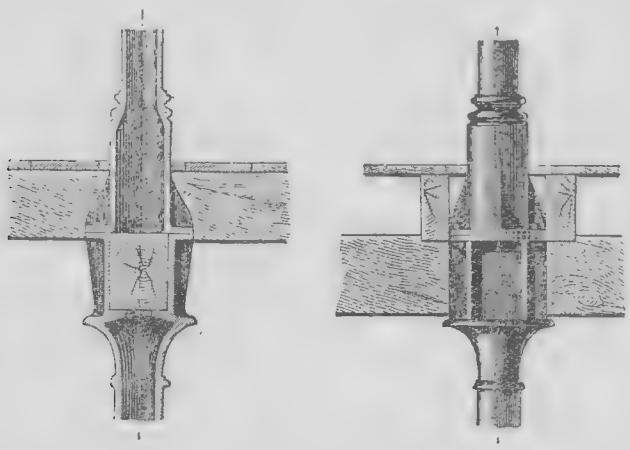
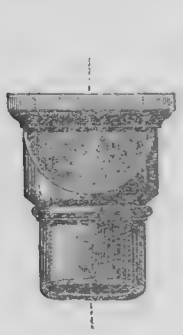


FIG. 372.



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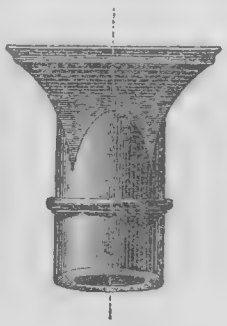

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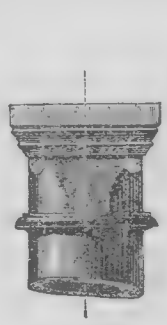

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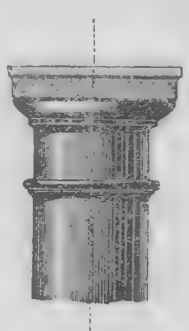


FIG. 376.

FIG. 377.

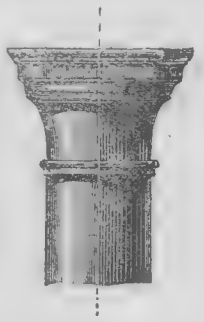


FIG. 378.

FIG. 379.

The heavier form of the Grecian Doric is unsuitable for machine construction, and is seldom used. More appropriate is the modified Corinthian capital shown in Fig. 377. The top is a cornice of overhanging leaves, terminating in an astragal on the shaft. By omitting the ornament the same form may be retained, as shown in the right-hand half of the illustration, and also in Fig. 348. The fluting of the column is by no means objectionable, at least in Germany. The fluted capital is readily cast by being made in a core box.

Fig. 378 shows a capital of Renaissance form with octagonal abacus, well suited for slender columns.

The support of beams, either iron or wooden, is best accomplished by the introduction of a plate between the column and the beam, and this may be treated simply, yet in harmony with the style of the rest of the work. Fig. 379 shows such a support on the cubic capital already shown, and is adapted for very heavy construction. Fig. 380 shows a lighter capital, in which the support for the beam is made of a box form; Fig. 381 is a still lighter design. This illustration also shows the effect of a high stylobate or base moulding, suitable for tall slender columns. As shown in this example, such bases are usually made octagonal in section, which approaches the Gothic style, but they are frequently made round. As in architecture, the columns are usually made tapering from below upward, the upper diameter being 0·8 to 0·7 that at the base. Fig. 382 shows a more elaborate form of capital and bearer.

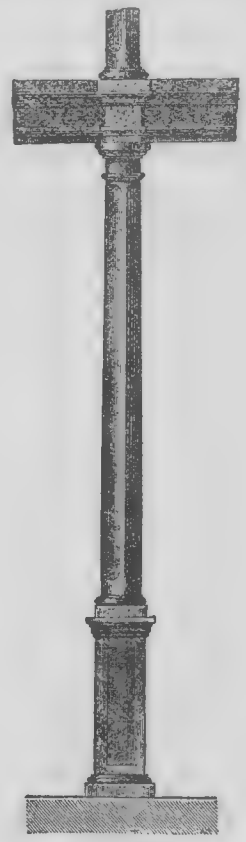
Columns of cruciform section, already referred to, are often used in the construction of industrial establishments. They are sometimes to be preferred to hollow columns, since the latter are often cast of such unequal thickness as to be unreliable. Figs. 383 to 385 show such a column. Fig. 383 is from the railway station of St. Germain. Here the flutings extend from top to bottom, and the column is swelled slightly in the middle. The form shown in Fig. 384, from the Tobacco Factory at Strasburg, is more elegant in its appearance. Here a rectangular base is used for the lower floor, but is omitted above. The method of connecting the base and column, as well as the connection between capital, beam, and column above, is shown in Fig. 385, in which the solidity and substantial character of this form of construction is well shown.

These examples will serve at least to show the variety of the forms of columns which may be used, and the manner in which a little ornament may be introduced into machine construction.

(*To be continued.*)

FIG. 381.

FIG. 383.



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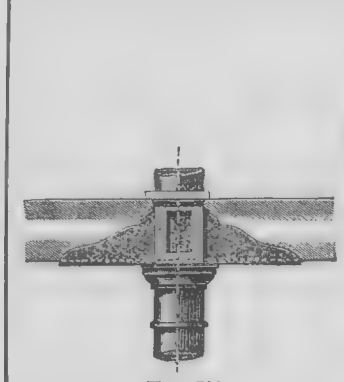


FIG. 380.

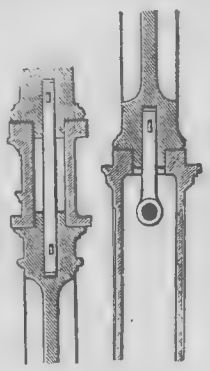


FIG. 385.

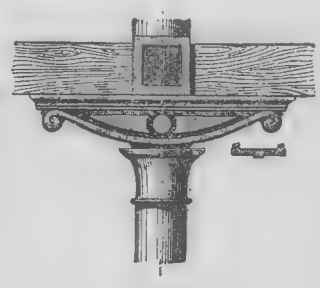


FIG. 382.

"Economic" Furnace Bars.

IT is a tolerably well-known but insufficiently-appreciated fact, that upon the amount of air passing through the bars of a boiler furnace depends the rate of combustion of the fuel and economy in steam generation. An increased supply of air, or an improved system of air admission to boiler furnaces, would in a large number of cases effect a very considerable economy in the use of fuel, while boilers at present overworked might, by slight modifications in the grate arrangement, be greatly improved in their steaming capabilities. To effect these objects, many forms of patent grate bars have been introduced from time to time, but some of these have proved lamentable and costly failures. The "Economic" furnace bar made by Messrs. Clarke and Co., Nottingham, is evidently not to be included in this category, as is evidenced by the number of repeat orders and testimonials which the firm have submitted to our notice. One firm near Manchester was contemplating putting down a larger boiler, owing to shortness of steam, but with Messrs. Clarke's bars no difficulty was experienced in furnishing the required amount of steam. The makers claim that the first cost of these bars is but little more than that of plain bars, while the saving of fuel effected in a few months more than covers the slight extra expense. Messrs. Clarke claim to be the largest makers of chilled-faced circular bars, which are suitable for all kinds of vertical boilers.

Foreign readers of THE MECHANICAL WORLD will oblige by sending their names and addresses to the Publishers, Emmott and Co. Ltd., Manchester, in order that they may have an opportunity of specially communicating when anything crops up which cannot be published in the columns of the Journal.

* Other forms will be found in Brandt's Eisenkonstruktion, Berlin, 1865.

† Shown, among other places, in the Osten Lloyd, in Trieste, and in the Arsenal at Vienna.

A Practical Consideration of Compressed Air.

(*Concluded from page* 15.)

FIG. 8 illustrates an economical condition of compressed air used in mines and tunnels. The power is generated electrically and is conveyed by wire to a point within a few hundred feet of the heading where a rock drill is at work. By means of an electric air compressor hot compressed air is produced adiabatically, and is expanded adiabatically in the cylinder of the drill, following closely the economical conditions illustrated and described in Fig. 1. Such a state of things as this admits of an electric installation in the mine for the purpose of haulage, lighting, traction and pumping, to all of which uses electric energy has been successfully applied, and it gives us a means by which a compressed air drill may be successfully and economically operated at the heading. The air may be taken from the mine, and when exhausted at the drill it serves to keep up a circulation in so confined a space as a heading, and as it is exhausted at atmospheric temperature there is no material change in the temperature of the mine. In some cases the air may be drawn through a flue from the outside, and thus, through compression and expansion, it will serve to ventilate the mine, as it does in the case of a compressed-air installation. The economy of the system depends to its greatest extent upon the economy of electric production and transmission. Electrical engineers tell us that they can deliver electric energy several miles from the generating station with an efficiency of 80 per cent. If this is true its conversion into compressed air, and its use as a power under the conditions shown in the illustration, may be accomplished at a very moderate reduction of efficiency, because, as is plainly seen, the losses commonly incurred in compressed-air service do not here take place. Electric rock drills are subject to many costly limitations. Thus far they have not been successful, and it is a serious question whether or not it is possible to accomplish the drilling of rock by the percussive principle (which is the only true one) by an electric engine which will be equal in weight, in price and efficiency, to an air engine. The weight of a rock drill is one of its most conspicuous limitations, and from every basis of theory and practice a compressed-air percussive engine will weigh less than half that of an electric engine of the same power. An electric drill is made of copper, which cannot compete in price with iron, and the durability of the apparatus is apparently in favour of the air drill. But as mines are likely to be lighted by electricity, and as there are many conditions of work favouring electric transmission for other purposes, we here have a means by which all the advantages of the air drill are maintained in an electric installation.

Fig. 9 illustrates what may be called an endless chain of pneumatic power. An air compressor draws its supply of air from a receiver in which there is a pressure of 20lb. The air is compressed to 60lb., and is carried down a shaft and used to drive a pump. The exhaust of the pump is returned to the initial air receiver; and thus the same air is used over and over again, all of the exhaust pressure being utilised. As pumps usually exhaust at pressures from 20lb. to 50lb., a large saving is effected in this alone.

When starting, it is simply necessary to open a valve on the initial air receiver until a pressure of 60lb. has been reached in the secondary receiver; the valve is now closed and the work goes on. The economy of this system is apparent. The heat of compression is converted into work in the pump, and a very low temperature of air is maintained. The economy of low initial temperature in air compression has been fully set forth in a diagram which I have published in "Compressed Air Production," and a power diagram of such a system as this indicates several other economical points, notably the admission of compressed air instead of free air through the inlet valves, which serves to reduce the heat loss during compression and to equalise the resistance strains in the engine.

Fig. 10 illustrates in contracted form a complete pneumatic installation comprising boiler, air compressor, air receiver, air injector, supplementary air receiver, pipe for transmission, reheater and air engine. The reheater and air engine should be considered as situated from 1000ft. to several miles from the compressor.

It will be observed that atmospheric air is drawn in the piston inlet tube of the compressor at 60° temperature. It is compressed adiabatically—that is, without any provision for cooling during compression—and in this way all of the power expended in the steam cylinder is converted into heat, which remains as power in the air. Perfect adiabatic compression, as previously stated, cannot be attained because of the absorption of heat by the metallic surfaces, radiation, etc. For the sake of illustration, however, the figures are given at adiabatic compression.

Now we have seen that if all of this heat can be utilised, it will return 100 per cent. in power, less such small items as

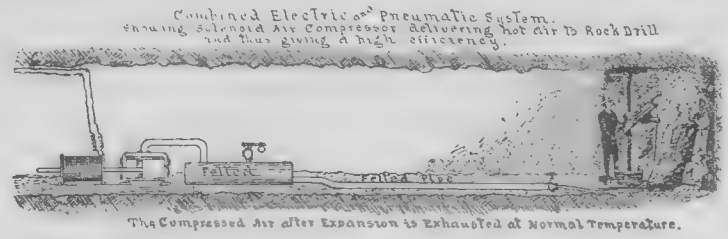


FIG. 8.

friction, leakage, etc., and the purpose of this sketch is to call attention to a means by which at least a large part of this heat may be saved, and not wasted by radiation into the atmosphere or by absorption in water. An air injector is located between two air receivers, and the highly compressed or the highly heated air from the first receiver is admitted through the nozzle of this injector, and is thus converted into high velocity inducing free air from the atmosphere, and discharging an increased volume at a reduced pressure and temperature into a secondary receiver. For

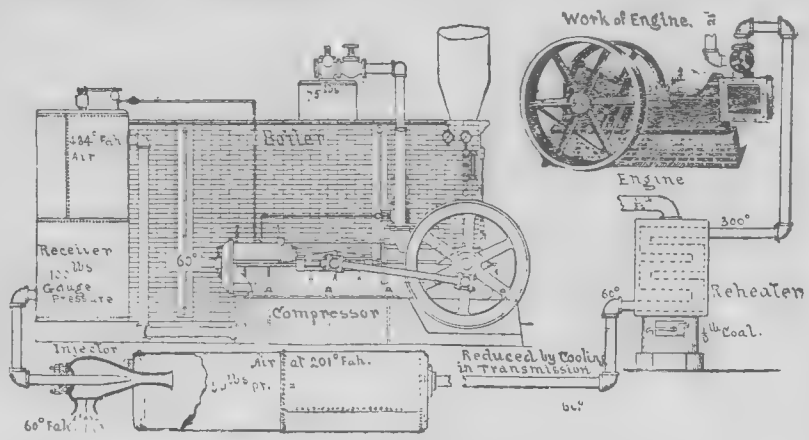


FIG. 9.

the sake of illustration, the pressure in the first receiver is taken at 100lb. and is reduced to 50lb.

This air injector has been tried with success, though the experiments have not gone far enough to determine to what extent it will effect a saving in the production of pneumatic power. It has been found that with a pressure of 80lb. in the first receiver, the injector will work discharging and inducing free air into a second receiver in which is maintained a pressure of 60lb. This difference of pressure may obviously be modified by the

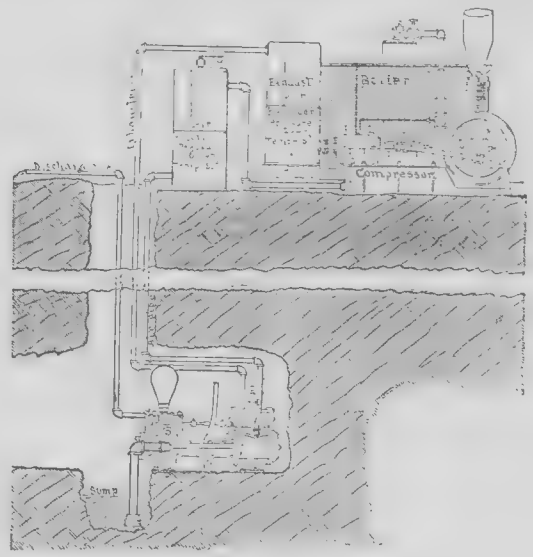


FIG. 10.

shape of the nozzle, sizes of pipes, etc., and it is probable that the injector may be made to work at a difference between the two pressures of only 10lb.

The principle is similar in many respects to that of the boiler-feed injector, about which there are so many mysteries. We know that not only is it possible to feed a boiler through an injector which takes the steam at a pressure lower than the boiler pressure, but the exhaust injector is a practical success. That we may exhaust steam from an engine, and, by means of such exhaust, feed water to the boiler which supplies the engine with live steam, is indeed a mystery, and it is fair to assume that equally valuable and surprising results may be obtained from the induced-air injector.

Mr. Green, the inventor of the Green system of ventilation, which is used on transatlantic steamers, is now conducting experiments with a view to the ventilation of Forty-second Street tunnel, New York, by means of air induced through an injector. His experiments have shown that one volume of air, when passed through the nozzle of an injector at a pressure of 5lb., will induce 30 volumes of free air—that is, a volume efficiency of 30 to 1. Mr. Green measured his air by means of a meter.

His conditions were similar to that outlined in the sketch, differing only in degree, and while it is not expected that so large a percentage of volume in free air may be induced, yet on the basis of figures alone, when compared with Mr. Green's experiments, we might expect from three to five volumes.

The velocity with which compressed air is discharged through a nozzle does not differ materially at pressures of 15lb. and over. The actual velocity with which compressed air at five atmospheres is discharged through a short pipe is 658ft. per second, and at ten atmospheres the velocity is 649ft. per second. This is because high-pressure air is more dense than air at a low pressure, and just in proportion as the density increases does its resistance to movement increase. This is one of the limitations to the pneumatic dynamite gun. They started on about 500lb. pressure, and fell short of the mark. It appeared that it was only necessary to increase the pressure to increase the range, but the limitations were soon discovered.

With air discharged through an injector nozzle at a velocity of 650ft. per second, it is easy to understand that free air will be induced and discharged with it into a secondary receiver. The nozzle should be constructed so as to offer the maximum amount of contact for the minimum volume of discharge, and such a nozzle has been built by Mr. Green. It takes hold of the induced air not only on the outside but also directly in the centre or core of the jet.

This is not a case where something is sought from nothing. The hot compressed air is converted into high velocity, and thus the heat of compression is utilised. Were it not utilised in this way, it would simply be discharged into the atmosphere by radiation, which is the usual practice in long-distance transmission in America.

Compressed air cannot be produced isothermally. In spite of the best system of injection, combined with water jackets and a complicated apparatus, there will still be the heat of compression influencing pressure during compression. Compressors have been made which show cold discharge pipes and passages, and cold air in the receiver; but the largest part of this reduction in temperature has taken place *after* compression. If we cannot keep down the heat during compression, and if it be true that in keeping it down even to a reasonable extent large complications are involved in the machinery, why not let it be produced, and so simplify the apparatus? Then let this hot high-pressure expanded air be discharged through one or two injectors until its temperature has been reduced to a point approximately to what it will inevitably reach during transmission; and thus we have converted the heat of compression into air volume.

The reheater shown in the sketch is little more than a common stove, the air pipes passing through the furnace. This saves volume of air only; it cannot increase the pressure. The engine which is driven by the compressed air should be provided with an automatic cut-off, and to ensure economy it should exhaust at atmospheric pressure. It is obvious that when exhausting at atmospheric pressure, it will also exhaust at a comparatively high temperature, unless the air is first admitted at a pressure sufficiently high to admit of early cut-off and complete and economical expansion. This points to economy, under some conditions, by using high-pressure air in an engine which works in connection with a system of reheating, and it also points to the highest economy, which will be shown by that system which follows the conditions shown in the sketch, but which reheats or rather explodes the compressed air behind the piston of the air engine after admission and cut-off. This principle has been verified to some extent in certain oil and air engines, notably the Priestman and Grigg, which have recently been brought to the attention of engineers.

Society of Engineers.

ON the 20th July a visit was paid by the Society of Engineers to the A B C Sewage Works, Kingston; the Southwark and Vauxhall Water Company's Works, Hampton; and Messrs. Willans and Robinson's Works, Thames Ditton.

Kingston Sewage Works.—The works have been constructed for treating, by the Native Guano Company's processes, the sewage of 35,000 people; but with certain comparatively inexpensive additions they will meet the requirements of a population of 50,000.

At present the sewage being treated is that of

Kingston with a population of.....		27,057
Surbiton	,, ,, ...	10,052
Hampton Wick	,, ...	2,378
Total		39,487

The Kingston sewage, on reaching the works, passes into the screening chamber and through a grating, which intercepts coarse matter likely to choke or injure the pumps, and thence through a culvert to a pump well under the main building, where it receives the "B C," or deodorising and purifying mixture. The sewage thus partially treated is raised about 12ft. by centrifugal pumps, of which there are three, each driven by a 15H.P. engine, and capable of lifting 1650 gallons per minute. The pumps discharge into a meter chamber where the sewage is measured and the quantity registered. On leaving the meter the sewage flows along an open channel to the settling tanks, receiving on its way the precipitating agents. There are eight tanks, each 85ft. long by 50ft. broad and 6ft. average working depth, holding 150,000 gallons, or 1,200,000 gallons in the aggregate, which gives a capacity of 30 gallons per head for a population of 40,000. The treated sewage flows in a continuous stream through the tanks, precipitating as it flows, and passes clear, bright and odourless into a covered channel discharging into the Thames. The tanks are cleaned

periodically, the deposit or "sludge" being pumped into the sludge well by a Tangye-Holman double-action pump at the rate of 500 gallons per minute. From this well the sludge is first drawn into 6 sludge vessels, or accumulators, by the creation of a vacuum, and is then forced by air pressure, at 100lb. on the sq. in., into filter presses on the first floor of the building, from which it is removed in hard cakes. There are three of Scott's air pumps and 16 of the Native Guano Company's filter presses. The pressed cakes are dried in a Borwick's drying cylinder (with fan and condensing apparatus attached), ground into powder, bagged, and sold as Native Guano at £3 10s. per ton. The Surbiton sewage is separately received and screened, and is pumped by centrifugal pumps through a meter into the Kingston pump well. There are three pumps, each driven by an 8H.P. engine, and capable of lifting 750 gallons per minute. The boilers are of the locomotive multitubular type, working at a pressure of 150lb. per sq. in.—one of 80H.P. and 2 of 60H.P. each. The two main driving engines, each of 40H.P., are used alternately, and like the pump engines are of Messrs. Willans and Robinson's patent kind. Two mortar mills are used for grinding the chemicals, which are then mixed in vats and discharged into the pump well; and there are two vats for dissolving the precipitating agents. A small centrifugal pump supplies water from the river for the boilers, mixing the chemicals, etc.

Southwark and Vauxhall Water Company's Works at Hampton.—The works at this station were commenced in accordance with the provisions of the Metropolis Water Act, 1852, the first supply being pumped from Hampton to Battersea, to be there filtered and distributed, on the 5th July, 1855.

In 1867, additional works were commenced on the adjoining land, having for their principal object the supply of the western portion of the district; these were completed and taken into use in the spring of 1870. The details of the present arrangements are as follow :—

A portion of the supply is conveyed through a 48in. conduit pipe to the subsiding reservoirs, from thence pumped by three engines of the direct-acting or "Bull" type through a 36in. trunk main under a head of 135ft. to the Company's works at Battersea, where it undergoes a further process of subsidence and filtration before it is again pumped to the district for distribution.

Another portion is conveyed through a 36in. conduit to three filters having an area of 3¼ acres.

It is not usually necessary to admit water at this point, as the supply to these works is supplemented by several million gallons per 24 hours from the natural filtration works hereafter described. It is then pumped by two sets of direct-acting rotative compound engines, against a head of 275ft., for delivery through 30in. and 42in. trunk mains, partly to the reservoirs at Nunhead and partly direct to the district.

A pair of Cornish beam engines are kept in reserve for the supply of this 30in. main.

The supply of water obtained from what is called the "natural filtration" system occupies two fields and an island, having a total area of 39¾ acres. The river water is admitted to these two fields through a vertical gravel filter, and the gravel subsoil is thus charged by a system of glazed earthenware pipes, 24in. diameter, laid with open joints.

The water, after having percolated through the sand and gravel, is collected by a system of 24in. earthenware pipes, laid with open joints on the surface of the clay.

The water is then conveyed through two 36in. conduits to the engine-house, and delivered to the filters before referred to.

Of the three direct-acting engines, Nos. 1 and 2 have cylinders 66in. diameter, with 10ft. stroke, and pump poles of 39in. diameter. No. 3 engine has a cylinder of 70in. diameter, 10ft. stroke, pump plunger 42in. diameter.

These engines are supplied with steam at 40lb. pressure per sq. in. by 13 boilers of the Cornish single-flued type, six of these being fitted with Vicars' mechanical stokers.

The compound direct-acting engines of the surface-condensing rotative type are arranged in two pairs, having cylinders 32in. and 52¾in. diameter, and 7ft. stroke, with two double-acting pumps 19in. diameter and 7ft. stroke, working against a head of 275ft.

These are supplied with steam at 100lb. pressure by six double-flued Lancashire steel boilers, 28ft. long and 7ft. 6in. diameter.

The engines of the Cornish beam type have cylinders 80in. diameter and 10ft. stroke. The pumps are double-acting, 24¾in. diameter, and have the same stroke as the steam piston; they usually work against a head of 240ft.

Steam is supplied by eleven single-flued Cornish boilers, at a pressure of 40lb. per sq. in.

The engines for lifting the water obtained from the Natural Filtration Works are arranged in two pairs.

No. 1 is a compound with cylinders 17in. and 32in. diameter and 2ft. stroke, jet condensing.

No. 2 is a tri-compound, having cylinders 9in., 13½in, and 27in. diameter by 2ft. stroke, surface condensing.

Each of these engines is geared in the ratio of 4 to 1 to a set of three single-acting bucket pumps 3ft. diameter by 50in. stroke, and each set is capable of lifting 16 million gallons per 24 hours.

These engines can be supplied with steam either from the Cornish boilers connected with the direct-acting engines or from a De Naeyer water-tube boiler, which when the tri-compound engine is in use is worked at a pressure of about 150lb. per sq. in.

Messrs. Willans and Robinson's Works.—The Ferry Works, Thames Ditton, were started in the year 1881, for the construction of steam launches and yachts, and for the manufacture of the marine form of the Willans engine, as then made. Soon after the engine was modified for land work, and was applied extensively for electric lighting, and in 1885 the present pattern, well known as the "central-valve" engine, was produced.

In November, 1888, the works were almost completely destroyed by fire, and in the following year they were rebuilt on a greatly improved plan. They include at present a foundry, containing a 20-ton traveller, driven electrically, and two cupolas with fans, driven by electric motors.

Close to the foundry is the machine shop (about 140ft. by 120ft.), a one-storeyed building, with a gallery along the west side. It has a weaving shed roof, the light coming from the north, and is divided into six similar bays, with interchangeable overhead travellers. At present one bay is used as a store for manufactured parts, and one corner of the building is also used as the experimental and testing department, but a new building is to be erected for this purpose in the space between the present machine and erecting shops. The present testing department boiler is capable of supplying steam for about 200 or 250I.H.P. up to 200lb. pressure, but two other boilers of equal capacity have been ordered, as well as a water-tube boiler for exceptional pressures, so that when the new testing arrangements are complete the largest engines at present made by the Company —of about 700I.H.P.—will be able to be tested to full power under steam before going away. Brake apparatus equal to at least this horse-power will also be provided.

The erecting shop, measuring 100ft. by 60ft., is commanded by an electrical overhead traveller, capable of lifting 25 tons, and, like the machine shop, has a weaving-shed roof, with north light; adjoining this is a building containing the pattern shop (the machinery in which is driven by an electric motor), pattern stores, and a mess room.

A complete system of gauging is in operation, and all parts of the engine are standardised, and are as far as possible kept in store.

A rigid system of inspection of work prevails, both after each operation and when the parts are finally passed into store. The inspectors are furnished with minute instructions as to the allowable deviations from standard dimensions, and are held responsible for any errors which may pass them. All work is passed through the stores on completion, and not directly to the erecting shop. There is a very complete apparatus for standardising electrical instruments, and the appliances for steam-engine testing are probably inferior to none in existence.

The Hydro-extractor.*

In recent years, both in the finishing-room and the dyehouse of nearly all textile manufactories, the hydro-extractor has become an absolute necessity. This machine, unknown as it was formerly, is made in such a way as to utilise the force in Nature by which bodies rapidly revolving about a centre have a tendency to fly off at a tangent from the circumference of motion. The faster the velocity the greater the centrifugal force, and the more readily the revolving body is thrown away from the centre of rotation.

The machine itself consists of a strong outward shell or hulk, from the centre of which is hung a vertical shaft. To the upright shaft is fastened the perforated basket in which the material to be treated is placed. Then, as the power is applied, the shaft and perforated basket revolve at a high rate of speed, and the superfluous water is thrown off into the outer shell and passed away. Simple and easily managed as the machine most certainly is, it is almost indispensable in the finishing or dyeing department, and as an aid to drying wools, woollens, yarns, etc., it soon pays for itself in time and labour saved. It may be said, however, in addition, that there is probably no one machine in the departments named, and perhaps in the whole mill, which is so often the cause of distressing accidents to property, life, and limb. To this feature of the machine and its use a few remarks may be very profitably directed.

The accidents which so often occur in connection with the running of the hydro-extractor are usually laid to carelessness on the part of the operative. But we are prepared to believe that this is only partly the case, and where loss of life or property do occur, it should be the business of the authorities to discover the true cause of the trouble, and then the neglect can be properly dealt with to prevent its recurrence at some future date.

Three special causes may be specified as being liable at all times to lead to trouble in the running of the hydro-extractor. The first is the speed at which the basket is made to revolve. If the velocity is allowed to get too great there is a fearful risk of danger, which all who have to do with the running of the machine should know. It is quite safe to say that three-fourths of the men who have these machines in charge are not at all conversant with the real facts of the case. For example, it is very commonly supposed that the faster the extractor is made to run, the larger is the proportion of water which is removed from the cloth or yarn contained in the basket of the machine. Now, it can be easily shown that this idea is really a mistake, and that the terrible speed at which some extractors revolve simply enhances the danger of damage and nothing more.

Accurate and careful observations have been made upon many of the extractors in actual use. The results of these observations have been compared, and the whole goes to show that many machines are now running as high as from 1800 to 2000 revolutions per minute. Now if this speed were really required to accomplish the work in hand, it would hardly be right to include the speed amongst the causes of accidents which might be done away with. If 2000 revolutions a minute were absolutely necessary in order to do the very best work, then it would be best to run at that speed, and see to it that our machines were so made as to be perfectly able to stand the enormous pressure and power. But as it can be clearly shown that there is no real necessity for any such speed, it is plain that a needless risk is incurred where they are allowed to exist.

A series of experiments have been made by a prominent firm of hydro-extractor manufacturers which will give some very interesting results. Anyone who has an extractor under his charge may try it for himself, and see that the conclusions are true.

An extractor running at a low speed is loaded with a batch of wet cloth just as it comes from the washing machines. After running for a certain observed length of time, the cloth is removed and weighed. The difference in weight before and after extracting is carefully noted. The pieces are wet up again, weighed, and loaded into the basket as before, while the speed is increased to a certain degree. After the same length of time as before the goods are removed and weighed once more. This process is repeated at several different speeds until a list of results is obtained from which the conclusions are drawn.

The experiments demonstrated beyond a shadow of a doubt that the greatest amount of water was removed from the goods when the extractor was running at 1500 revolutions a minute, and that nothing whatever was gained by running at a higher rate. The conclusion must therefore be drawn that every drop of water which can possibly be passed away from the goods by the action of the extractor is removed when the machine is running at a rate of 1500 revolutions a minute. When the rate is less than this, the machine is not doing the work it should, and when the rate is more, nothing is really gained, and the risk of damage is greatly enhanced. All extractors running at a higher rate of speed than 1500 revolutions per minute are only wasting force which might be used to better advantage, and needlessly imperilling property and life. It may seem as though a difference of 50 or 100 revolutions a minute was not worth mentioning, but it may be all that is required to cause irreparable loss.

The second cause of accidents lies in carelessness or neglect upon the part of the operatives in charge of the extractor. Careful hands only should be entrusted with the running of this machine. In two special ways the attendant must be particularly on his guard. First, he should always be careful not to drop any hard substance down between the shell and the basket. If by accident he should happen to do so, under no circumstances should he attempt to run the machine again until the article has been removed, even if it is necessary to take the machine apart in order to get at it. Second, he should bear in mind that he is not to lay a hand upon the cloth after the extractor is in motion. The peculiar twisting or rotating motion of the cloth in the machine while it is in rapid motion is apt to entangle a hand or finger very easily, however carefully the operative may try to prevent it.

The third cause of accidents lies in the materials and manufacture of the machines themselves. No machine should be bought or run in a finishing-room until its suitability has been well tested, both as to strength of materials and durability of workmanship. If both materials and construction are correct, then no trouble need be feared from this cause, unless the machine has not been properly and evenly loaded. If the cloth is laid into the basket in such a way as to make it heavier on one side than on the other, so that it has a wobbling motion when running, then even the best materials may have to succumb in time.

A small engine is found very convenient for running the hydro-extractor, as it enables the speed to be regulated at will, and to use the extractor when the other machinery of the mill may be stopped.

* "Manufacturers' Gazette."

Shipbuilding Notes.

Since the establishment of Government shipbuilding yards in Japan, 32 war vessels have been constructed for the Japanese Navy.

Russell and Co. launched from their Greenock yard on the 21st inst., a steel sailing ship to register about 1700 tons, and to carry 2850 tons deadweight, her dimensions being 259ft. by 39ft. by 22ft. 9in.

The armoured battleship "Agincourt," 10,690 tons, 5000H.P., is having her boilers removed in the steam basin in Chatham Dockyard, where she is to undergo an extensive repair. The "Agincourt" is intended to be fitted with the boilers originally supplied for the third-class armoured battleship "Penelope," 4470 tons, 4700H.P.

On the 23rd inst. Messrs. Richardson, Duck and Co., Stockton, launched from their yard a steel screw steamer of the following dimensions: — Length over all, 351ft.; breadth extreme, 42ft.; depth moulded, 29ft. 6in.; tonnage gross, about 3380 tons. Her engines, by Messrs. Blair and Co., are 250N.H.P., with two single-ended boilers of 160lb. pressure.

The Naval Construction and Armaments Company Limited launched from their shipbuilding yard at Barrow-in-Furness, on the 23rd inst., a steamer for Messrs. William Thomson and Sons, Dundee, named "Hurona." She measures 360ft. in length, 44ft. 6in. in breadth, and 29ft. in depth. Her engines, which are of the most approved type, have cylinders 29in., 44in., and 71in. diameter, by 54in. stroke.

Work upon the "Blenheim" is being rapidly pushed forward at Chatham, and the vessel will soon be ready for her trials. The combustion chambers, the defects in which gave a good deal of trouble, have been divided, and faulty boiler tubes removed, and little now remains to be done beyond completing the torpedo tubes. As was indicated by her preliminary trials, the "Blenheim" is fully expected to be a more satisfactory vessel than her sister, the "Blake."

The steamship "Transvaal," a steel spar-decked screw steamer, left the No. 2 dockyard of her builders, Sir Raylton Dixon and Co., Middlesbrough, for her official trial trip on the 4th inst., which proved a complete success. Her principal dimensions are:— Length over all, 323ft.; beam, 40ft. 6in.; depth moulded, 28ft. The engines have been fitted by Messrs. T. Richardson and Sons, Hartlepool, the cylinders being 24in., 38in., and 64in. by 42in. stroke, and the speed maintained during the trial trip averaged over 12⅓ knots.

On the 23rd inst. the screw steamer "Duke of York" left the Tees for her official trial trip. This vessel has been built by Sir Raylton Dixon and Co., Middlesbrough, to the order of Messrs. Robinson Bros., of Whitby. The principal dimensions are:— Length over all, 333ft.; beam, 41ft.; depth moulded, 24ft., her deadweight carrying capacity being about 4500 tons. The engines have been fitted by Messrs. Blair and Co. Limited, of Stockton, the cylinders being 23½in., 39in., and 64in., and 42in. stroke. The trial was very successful.

Brakes.*

BRAKES are contrivances attached to vehicles or moving machinery for the purpose of absorbing surplus energy. In the case of a vehicle, such as a tramcar, there are two conditions under which energy must be absorbed: First when the vehicle is descending a steep gradient at a steady rate; second, when it has to be brought to rest either on a gradient or on the level. It is obvious that the energy absorbed per second in the latter case will exceed that absorbed in the former, so that it will suffice if the brake is designed to be strong enough to bring the car to rest within a given distance. As the car will sometimes have to stop on a down gradient, it is evident that the maximum work the brake will have to do will occur when it stops the car on the steepest gradient on the track. This case only, therefore, need be considered.

The energy absorbed in bringing a car to rest from any given speed downhill is derived from two sources: (1) The kinetic energy of the car; (2) the work done by the car on account of its vertical descent during the time the brake is in action.

In Fig. 1 let l represent the distance along the track in feet in which the car is brought to rest, and h the vertical fall in that distance owing to the track having a gradient, ϕ. Let v be the velocity of the car in miles an hour, and W the weight of

FIG. 1.

the car in tons. Then the energy absorbed in stopping the car, in foot pounds, will be: $E = 75{\cdot}6\ W.v^2 + 2240.W.h$, and $h = l.\sin\phi$, $E = 75{\cdot}6\ W.v^2 + 2240\ W.l.\sin\phi$. In most brakes this surplus energy is absorbed by friction, by means of blocks of wood or cast iron pressed against the rim of one or more wheels. The energy is then wasted, developing heat and wearing away the brake blocks. Let F be the force of friction in pounds due to all the brake blocks on the car or train, then the work done against friction is: $E = F.l$ foot-pounds, whence $F.l = 75{\cdot}6\ Wv^2 + 2240.W.l.\sin\phi$, and

$$F = \frac{75{\cdot}6\ Wv^2}{l} + 2240.W.\sin\phi.$$

It is usual to proportion the distance l to the square of the velocity of the car at which the brake comes into action as follows:—$l = 0{\cdot}6\ v^2$ for tramcars, $l = 0{\cdot}4\ v^2$ for railway trains. Whence $F = 126{\cdot}0\ W + 2240.W.\sin\phi$. (tramcars), $F = 187{\cdot}5\ W + 2240.W.\sin\phi$. (railway trains).

This amount of force at the wheels of the vehicle must be obtained by the provision of a suitable amount of brake block

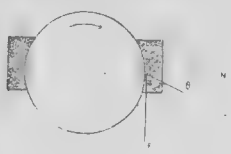


FIG. 2.

bearing surface, and by means of a brake-applying gear capable of exerting a certain pressure between the blocks and the rim of the wheel. In Fig. 2, let F be the friction acting tangentially to the wheel, and N the pressure normal to the rim. Then

$$N = \frac{F}{\mu}$$

where μ is the coefficient of friction for the materials of the block and rim. The two forces, F and N, are compounded into a resultant thrust along the line P, at an angle θ with the radius of the wheel, where θ is the angle of friction, and $\tan\theta = \mu$. Consequently, in order that the thrust P may not twist the block on one side, the force exerted by the brake rod must be in the line of P, equal and opposite to it. The brake rod should not supply a force to the blocks quite at right angles to the rim of the wheel, but should be tilted forward in the direction of motion of the wheel by an amount equal to the angle θ. The amount of the force which this rod must exert is determined as follows:—

$$P = \frac{N}{\cos\theta} = \frac{F}{\sin\theta}$$

The normal pressure on the block must not be concentrated on a very small amount of surface, or the brake will get too hot and excessive wearing will occur. Moreover, the crushing strength of the material of the block being low, and a high factor of safety being necessary, it is impracticable to have a pressure exceeding 30lb. per square inch except for very strong blocks with power brake-applying gear. The material of the block should be softer than the rim of the wheel, so that the former and not the latter is worn away; yet it must be capable of standing a fair amount of crushing pressure. The following table gives the usual practice for the three most common timbers, together with the coefficients and angles of friction on steel tyres.

	Pressure per sq. in. surface. Power Brakes.	Hand Brakes.	μ	θ
Oak	50 to 80lb.	30lb.	0·5 to 0·6	26½° to 30°
Elm	50 to 100lb.	30lb.	0·25	14°
Beech	50 to 80lb.	30lb.	0·25	14°

Let p be the safe pressure per square inch, as given in the above table, and A the required area of brake surface, then

$$A = \frac{N}{p} = \frac{P.\cos\theta}{p}$$

The total amount of brake surface having been obtained, it is good practice to divide this into two or more pairs of blocks; putting each pair on a separate wheel at opposite ends of a diameter, so as to produce as little thrust on the axle as possible. Each block must not be larger than will embrace about one-sixth of the circumference of the rim, as the greater part of the thrust would otherwise be ineffective owing to the curvature of the rim. The total force of friction on any one wheel must be less than the tractive force of that wheel—*i.e.*, it must be less than the grip of the wheel on the ground, otherwise the wheel will skid when the brake is applied. A brake should never be applied so forcibly that the wheel is caused to skid, as thereby the friction on the wheel is reduced and the car takes longer in coming to rest, to say nothing of the wear on the wheel and track. In designing a brake, care should be taken that the separate wheels are not overloaded with brake surface, and that as many wheels on the car are braked as will enable the full brake power to be applied without causing any wheel to skid. The actual number of brake blocks put on any car or train will therefore be determined by these considerations.

Hand-brakes require about three seconds to bring them into action. The brake-applying gear should be so designed that full brake power can be applied by a force not exceeding 20lb. at the brake handle. A man can pull with greater force than this; but where a brake has frequently to be applied, it is not well to expect the brakesman to exert more than this figure. The rods coupling the brake handle with the blocks are sometimes arranged to be under compression when the brake is applied; but this is bad practice, as it involves the use of stout stiffened rods to obviate bending. It is much better to arrange the gear so that all the rods are under tension when the brake is in action, as rods of light round steel can then be used. If the rods are under tension, a working stress of 8000lb. per sq. in. section may be used for wrought iron and 9000lb. for mild steel. If under compression, the working stress will depend on the ratio of the length to the least diameter, but will never exceed one-tenth of the above figures.

* By E. T. Carter, in the "Electrical Review."

Automatic Stamp Distributing Apparatus.

DURING the last twelve months a number of automatic stamp distributing machines have been placed in various parts of the Metropolis, with a view to determine how far they were likely to meet with public favour. The result of the experiment has been so satisfactory that it is now intended to place the machines out for general use throughout the United Kingdom. The experiment also served to develop defects in the machine, but these have now been remedied. When a penny is placed in the slot and a turn is given to a handle, a little packet, 3½in. long by 2¼in. wide, is presented, and easily extracted from an aperture. This packet is an envelope containing a small memorandum book carrying the penny postage stamp in a slit in the cover and enclosing a small card. On this card a short communication can be written; the card can be replaced in the envelope, the latter closed, addressed, stamped, and at once posted in the pillar box or at the receiving house near which the machine may be placed. The memorandum book, which is interspersed with useful information and advertisements, upon which latter the company's remuneration depends, can be retained for use. It would appear that the apparatus is likely to become popular with the public, as it is calculated to meet a want that has long been felt.

On Surface Coolers for Injection Water.†

THE author, having been led by the rise in the price of coal to adopt a condenser to a non-condensing steam engine of 70H.P., and being unable to obtain a fresh supply of cold well-water for more than ten minutes at a time, was obliged to resort to the principle of artificial cooling in order to use the same water continuously. After discussing several methods, such as cooling tanks, open gradation works, and others, he describes the plan adopted, which is to divide the hot water into narrow streams which fall through a system of vertical channels against a rapid current of air moving in the opposite direction. In the first form the apparatus consists of a rectangular wooden tower 7·5 metres high, 1·9 metre long, and 1·3 metre broad, the upper half of which is divided into narrow passages by twenty-six boarded partitions spaced 10 centimetres apart, while the lower half is an air chamber supplied by a fan with spiral blades 1·2 metre in diameter fixed in one of the sides. The water to be cooled is delivered from a pipe at the top and passes through the intervals between the boards against the upward current of air, which moves at about 6½ metres per second. The effect is twofold; the air acting partly by directly absorbing heat and partly by evaporating and absorbing water vapour, the relative value of these two factors being different at different times of the year. In winter the air works principally by direct cooling, but in summer, when its absorptive capacity for vapour is increased two and a half fold, the cooling is mainly due to evaporation; the final result being tolerably constant throughout the year, the vacuum in the condenser varying between 70 and 73 centimetres of mercury. The cooled water is reserved entirely for condensing, being too greasy for feeding boilers, so that it is constantly receiving new water in the discharge from the condenser. Theoretically, therefore, this should give some increase of volume in the circulating water, after allowing for evaporation to the air, but in practice it is found that the quantity is constant, except occasionally on the coldest days of winter, when a small amount is sometimes run to waste from the collecting cistern, which is placed underneath the air chamber.

A curious consequence of the use of the same water over and over again for condensing is that a higher vacuum is obtained from it than might be expected from its temperature. Thus, in five comparative experiments the same reading of the vacuum gauge (70 centimetres) was obtained with the same water, returning at intervals of ten minutes to the condenser as with fresh well-water; the temperature in the former case being 27° to 28° C., and in the latter 12° to 13°. This is due to the circumstance that the rapid circulation causes the injection water to be practically free from air, while in the case of spring or other natural waters the air-pump has to remove the dissolved gases, and thus a worse vacuum is obtained than with distilled water. It might be supposed that the intimate mixture of water and air would lead to reabsorption of the latter, but this does not take place, partly from the short time of contact, but more particularly from the circumstance that the energy promoting separation of air in the air-pump is measured by the pressure of the atmosphere, or 10,300 millimetres water pressure, while that of the air blast is only 5 millimetres, or $\frac{1}{2000}$th part of the former.

The space required for the apparatus is only about $\frac{1}{100}$th of that of a cooling pond; a surface of 3·5 square metres being sufficient for 100H.P., that of the boards being calculated at 3 square metres per H.P. The air pressure is 5 millimetres of water, the velocity 6·5 metres per second, and the volume required about 2000 times that of the water, about 2 per cent. of the latter being absorbed as vapour. In order to promote intimate contact between air and water, it is found to be better not to use boards in single lengths of the full height of 6 metres, but to divide them, placing the lower half at right angles to the upper one, whereby any dry kernels of air from below are brought into contact with the wet surfaces in the upper part. Care must be taken to lay the water on to the boards so as to flow smoothly over them and to prevent all spirting. The cooling effect of the apparatus when the boards are placed horizontally is only one-half of that of the vertical form.

The wear of the apparatus is very small, the fatty matters brought over by the condensed steam are partly deposited in fine films on the surface of the boards, and protect them from rotting, while the remainder collects on the surface of the water of the tank and is collected at intervals of two months for conversion into wagon grease. The load on the engine is increased by about 3 per cent. by the work of the fan, and from 1½ to 3 per cent. by the circulating arrangement, which may be effected by the air-pump directly or by a centrifugal pump. As the advantage gained by condensing is about 30 per cent. in an engine of moderately good quality, the net saving is about 25 per cent. Numerous examples of the application of the method to engines of different kinds are given in the paper. It has been adopted or is in course of construction in thirty-five different establishments, the largest example being on a central condensing plant for engines of 2500H.P., at the iron and steel works of Dudelingen, in Luxemburg.

† Inst. C.E.: Foreign Abstracts.

Trade Notes.

Messrs. George Mills and Co., Globe Ironworks, Radcliffe, are fitting a number of print works and paper works with their automatic sprinklers.

Mr. J. Moran, Harwich, has contracted to supply 360 lineal yards of 12in. cast-iron pipes, with sluices, etc., to the Harwich Corporation for the sum of £380.

The Round Oak Iron and Steel Works Limited have received an order from the Mersey Docks and Harbour Board for a twelve months' supply of short-link crane chains.

Messrs. Norton Brothers, Chicago, have booked an order from the Fairwood Tinplate Works, Gowerton, near Swansea, Wales, for two sets of Norton automatic palm-oil tinning machines.

The directors of the Rhymney Railway Company recommend a dividend at the rate of 10 per cent. per annum for the past half-year, against one of 6½ per cent. per annum this time last year.

The directors of the Newcastle and District Electric Lighting Company have declared an interim dividend at the rate of 5 per cent. per annum for the half-year ending June 30. This is the same as the dividend paid for the corresponding half of last year.

The Whessoe Foundry Company, Darlington, have obtained the contract for supplying and fixing six annular condensers at the Chorley Gasworks, for the Chorley Corporation. The amount of the company's tender was £426.

The accounts of the North-Eastern Railway Company for the half-year ended June 30, subject to final audit, show a balance which will admit of the payment of a dividend on North-Eastern Consols at the rate of 3 per cent. per annum. For the first half of 1891 the dividend was at the rate of 6 per cent. per annum.

In England, Ireland, and Wales there are 1048 works, including 229 alkali works, registered under the Alkali Act. Mr. Alfred Fletcher, the chief inspector under the Act, says that at the town of St. Helens, covering about three square miles, the processes of copper, lead, and glass making, with the consumption of 1,040,000 tons of coal, discharge annually 36,108 tons of sulphur into the air, the figures being about the same in summer and winter.

Representatives of the Amalgamated Society of Engineers, Boiler Makers, Iron Shipbuilders, Plumbers, and Labourers, met the employers on the 21st inst., to consider the notices given of a reduction in wages of 10 per cent. for men earning 30s. weekly, 7½ per cent. for men earning 20s. to 30s., and 5 per cent. under 20s. The men offered 2½ per cent. reduction if an eight-hour day were conceded, but this was refused, as was also a subsequent proposal of 5 per cent.

The total output of anthracite coal from the Pennsylvania pits this year, up to July 2, is returned as 19,638,238 tons, showing an increase of 1,264,001 tons as compared with the corresponding period last year. The output, in fact, continues to increase year after year, and should increase the net earnings of the coal railways. Meanwhile, though the trade is quiet for the time being, according to the latest Philadelphia advices no company is accepting new orders except at the advanced prices.

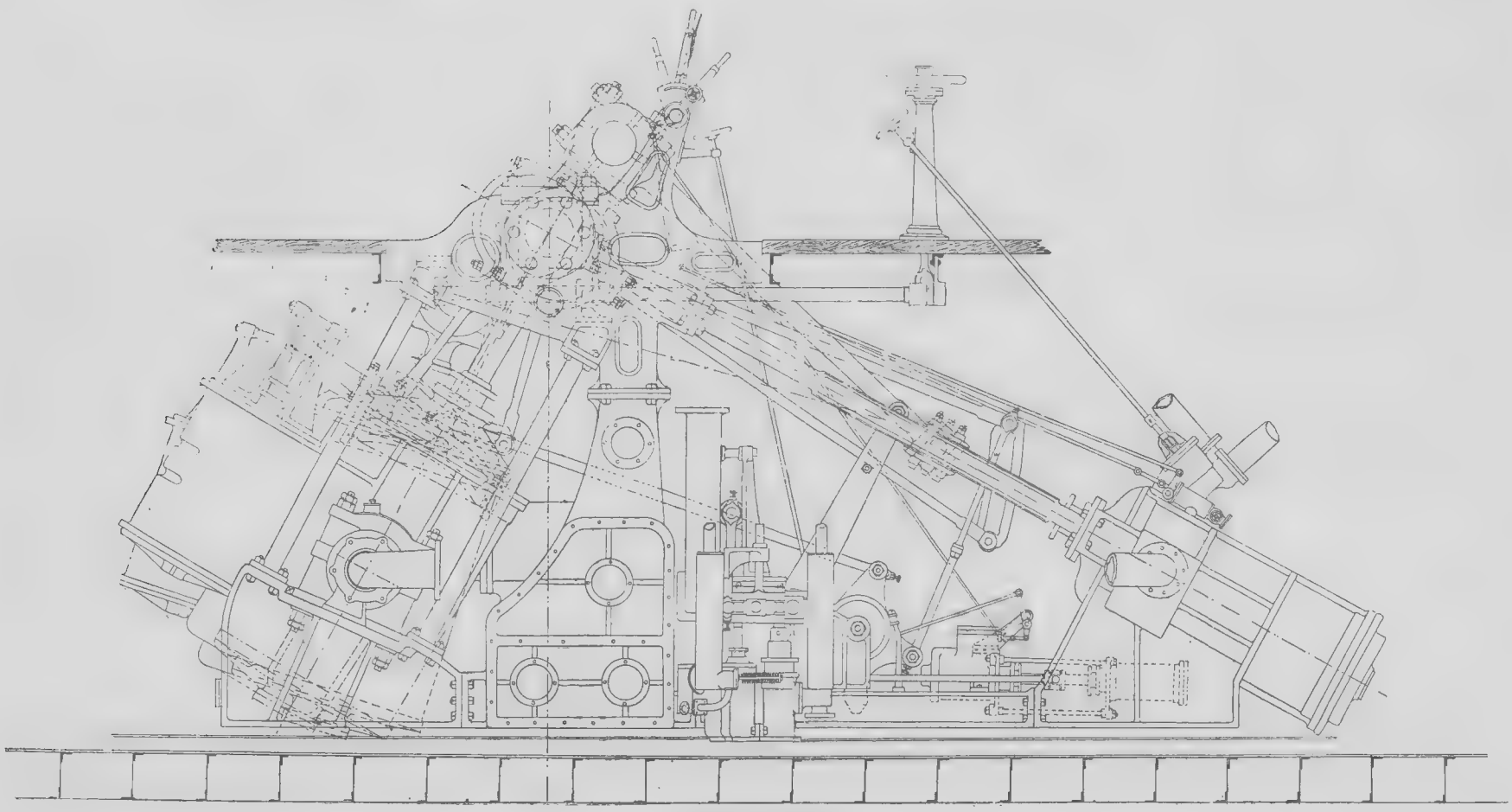
Wheel cutter in metal only. Every description of gearing. R. CHIDLAW, 43, City-road, Manchester.

The "Tool and Machinery Register" contains 4000 lots, new and second-hand, for sale and wanted; 2d. post free. Britannia Company, Colchester, and 100, Houndsditch, London.

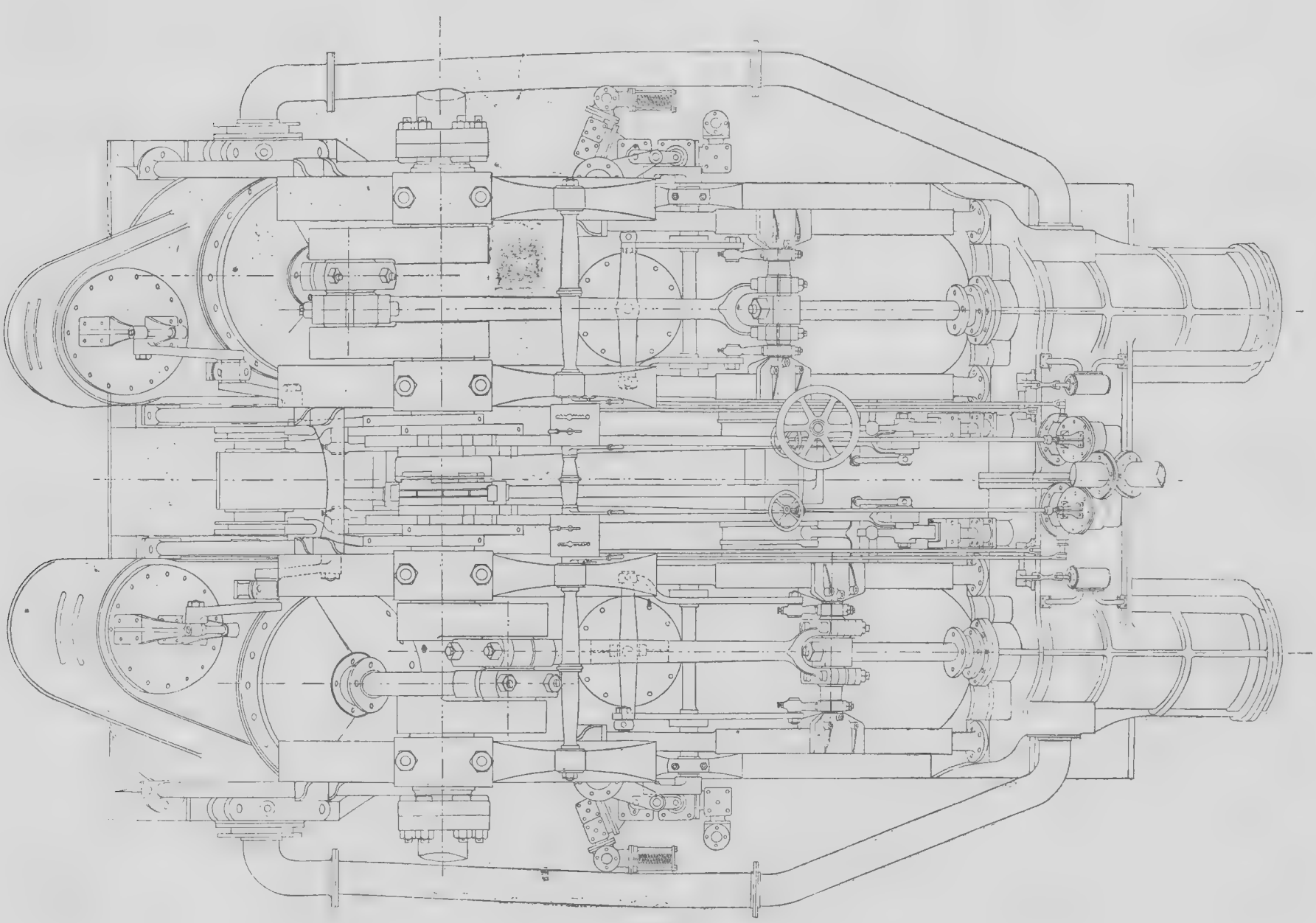
Having regard to the enormous circulation of THE MECHANICAL WORLD, the Editor suggests that it is by far the best medium for the insertion of every kind of "Wanted" advertisement, and the price is only one halfpenny per word. The Editor will be glad if MECHANICAL WORLD readers will kindly bear this in mind as occasion arises.

ENGINES OF THE PADDLE STEAMER "EXPRESS."

MESSRS. JOHN SCOTT AND CO., ENGINEERS, KIRKCALDY.



SIDE ELEVATION.



PLAN.

Engines of the Paddle Steamer "Express."

On the opposite page we give illustrations of the propelling machinery of the new passenger paddle steamer "Express," built and engined by Messrs. John Scott and Co., Kirkcaldy and Kinghorn, for the Morecambe Steamboat Company Limited, for their passenger service between Morecambe, Blackpool, the Isle of Man and North Wales. Messrs. Scott and Co. have gained for themselves a high reputation as builders of paddle steamers, and the latest addition to their list will, we doubt not, worthily sustain that reputation.

The "Express," which is the sixth addition to the fleet of passenger steamers owned by the company, is 202ft. long between perpendiculars, 24ft. beam, 10¼ft. deep, and of 428 tons measurement. She is built of steel, and has a straight stem and elliptic stern, flush deck aft, with awning deck over engines, also topgallant forecastle. A large promenade upper deck has been provided in the centre of the vessel between the paddle boxes, and is 65ft. long, fitted with seats all round and also in the centre.

The propelling machinery consists of two distinct sets of engines, one set to each paddle wheel, the high-pressure cylinders being diagonal direct-acting, and the low-pressure cylinders oscillating. Two of the cylinders are 25in. in diameter, and the other two 45in. by 54in. stroke. A strong steel clutch is provided in the centre, so that the engines can be connected after the steamer is in clear water. Two large boilers, one forward and the other aft of the engines, supply steam at 100lb. pressure. On the trial trip the engines indicated 1200H.P., and the speed of the ship, taken from the mean of several runs on the five-knot distance, was found to be over 15¼ knots, the speed guaranteed being 15 knots. During the official trial the engines worked with perfect smoothness, without heating of bearings or any other trouble.

The "Express" was successfully launched with steam up on the 12th of May last, and has proved herself a splendid sea boat, having had some rough weather on the passage round. On her first four runs between Blackpool and Llandudno she covered the distance in three hours average time, sometimes being three minutes under the three hours. The distance between Blackpool and Llandudno is 44 knots.

We are indebted to the "Steamship" for the illustrations of the engines of this vessel.

Anderson's Expanding Bit.

The illustration herewith shows a simple and efficient form of expanding bit for boring holes in timber, of which Mr. J. Anderson, 3, Poulton-road, Seacombe, is the patentee and maker. As will be seen, a supplementary blade is pivoted to the upper end of the stem of the bit. An adjusting screw passing through the centre of the length of the bit determines the position of the supplementary blade, the head of the screw bearing against the edge

of the blade, as shown. Another small screw near the cutting edges serves to secure the movable blade in position. The bit is certainly very simple and inexpensive, and will doubtless be found of great service by pattern makers and wood workers generally.

Mr. Norman Tate, the analytical chemist and chemical engineer, died on the 22nd inst., at his residence, Oxton, Cheshire. Of late years Mr. Tate had closely studied the explosive properties of petroleum. His book, "Petroleum and its Products," was translated into the French and German languages. Mr. Tate was a leading member of Liverpool scientific societies.

Sugar-making Machinery.—XV.

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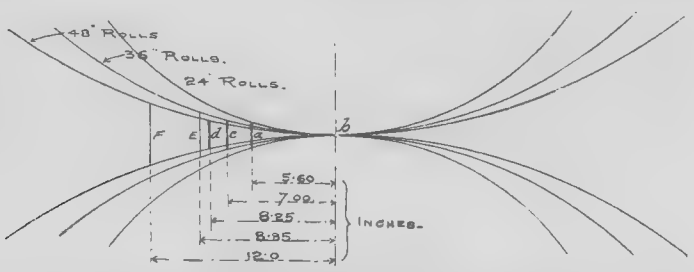
Speed of Rolls.—The surface speed of the rollers is a point of great importance, and varies from 10ft. per minute in the large to 20ft. per minute in the small sizes.

The maximum pressure exerted by any mill is practically instantaneous, and the length of time during which the pressure acting upon the canes is approximately at its maximum will depend on the diameter of the rolls and their surface speed. This is well shown in Fig. 30, from which it will be seen that the larger the diameter of the rolls, the longer the "nip" or pressure on the canes.

This fact was pointed out in a paper written by Mr. Robert Graham for the Poonee Agricultural Society and translated in the "Sugar Cane." In this paper he pointed out that "the triangular prism formed by two circles, when their circumferences touch each other, is more or less acute in proportion to the diameter of the circles. Plainer still, in order to fill the angle formed by the two circumferences, a wedge 3in. in breadth should be 5·60in. long in rollers 24in. in diameter, 7·08in. long in rollers 36in. diameter, and 8·25in. in rollers 48in. diameter. This will prove the superiority of rollers of large diameter. Their superiority, however, is not only on account of the larger pressing surface they show, but, above all, on the greater thickness of the layer of canes they can receive; and, on both these sources of superiority being added together, we see that they increase the pressing surface more than 100 per cent. This will be better understood by referring to Fig. 30, which shows the pressure to which the cane is subjected from its entrance into the mill through the top and cane rollers, to its exit through the top and megass rollers—that is to say, the mill's total pressure. The pressing surface, which begins in A and ends in B in 24in. rollers, is 5·60in. The pressure, with the same layer of canes, in rollers 36in. and 48in. in diameter, would begin at C and D, which are 7in. and 8·25in. distant



Sugar-making Machinery.—Fig. 30.

from B, showing an increase in diameter, and an increase of 47·35 per cent. in pressing surface for an increase of 100 per cent. in diameter. But, as the thickness of the layer of canes should increase in proportion as the diameter of the rollers augments, the pressure, beginning at A in 24in. rollers, would begin in 36in. ones at E, which is 8·35in. distant from B, showing 58 per cent. increase of pressure for 50 per cent. increase in diameter. In 48in. rollers the pressure begins at F, 12in. from B, giving 118 per cent. increase in pressure for an increase of 100 per cent. in diameter."

Mr. Graham then goes on to consider "the result of reduction of speed, which in modern mills is generally 18ft. per minute. The pressing surface in a 24in. roller is 5·60in., and the pressure, with a speed of 18ft. per minute, lasts 1·5sec. If the speed is diminished 50 per cent.—to, say, 9ft. per minute,—the pressure is augmented 50 per cent., or to 3secs., in a 24in. roller. In a 36in. one the pressure with the same speed will last 4·91 secs., equivalent to an increase of 327 per cent. In a 48in. roller the pressure would last 6·66secs., equal to an increase of 444 per cent.

"Adding these various augmentations of pressure, their result, as compared with those of a 24in. roller, at a speed of 18ft. per minute, would be as follows:—

50 per cent. increase in the diameter is equal to an increase in pressure of	58 per cent.
50 per cent. less speed is equal to an increase in pressure of	327 ,,
Total increase in 36in. rollers..	385 per cent.
100 per cent. increase in the diameter is equal to an increase in pressure of	118 per cent.
50 per cent. less speed is equal to an increase in pressure of	444 ,,
Total increase in 48in. rollers..	562 per cent.

"In other words, if in 24in. rollers, with a speed of 18ft. per minute, the pressure is equal to 1, in 36in. and 48in. rollers, with a speed of 9ft. per minute, the pressure would be 3·85 and 5·62, or nearly treble in the 36in. rollers, and nearly five times greater in the 48in. rollers.

"The advantages of this mode of construction are the following:—By the diminution of the speed we allow the juice to run free from the megass before the pressure is over. A large diameter in the rollers will give us a larger pressing surface, will admit of a thicker layer of canes being ground, and will allow of a greater solidity to be given to the axles, etc. Short mills require narrower cane carriers than long ones, and facilitate their being fed with greater regularity; the cane carriers' axles, being shorter, are less flexible. In grinding a thick layer of canes a slight imperfection in feeding the mill is not very important, as the canes being, so to say, semi-solid, they spread under the pressure, and fill all the empty places between the rollers."

Among other proportions for mills, he recommends as the result of his experiences a surface speed for the rollers of 9ft. per minute; piston speed of engine 240ft. per minute. To press 1 gallon of juice per minute 1½N.H.P. is necessary. The length of rollers should be 1½ time their diameter.

The average thickness in the layer of canes entering the rollers is 25 per cent. of their diameter, the speed of the rollers and cane carriers being the same, and the canes well distributed on the latter.

(To be continued.)

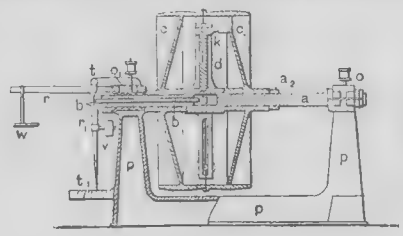


Fig. 1.

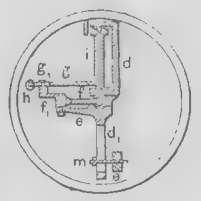


Fig. 2.

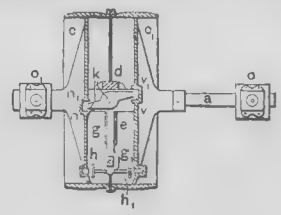


Fig. 3.

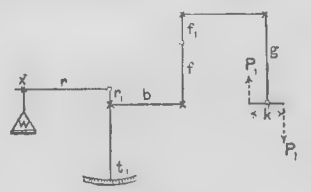


Fig. 5.

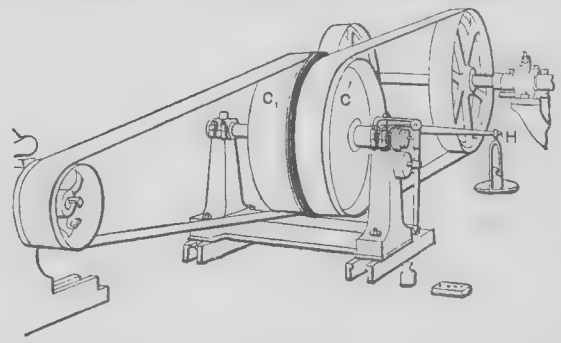


Fig. 4.

An Improved Form of Dynamometer.*

Recent years have brought few, if any, radical improvements in machinery for direct power measurements, although the complaint is very often heard from mechanical and electrical engineers that a simple and practical dynamometer is a decided want. We find the good old Prony brake as widely applied as any of the dynamometers, and now and then we come across some more or less, usually more, complicated truss construction of a cradle type; power scales will also be found to be applied to commercial tests with varied success. One generally finds that manufacturers were their own inventors, and introduced improvements in the way of automatic registers and other time saving appliances to one or other of the various well-known types.

In this article a description is given of a commercial dynamometer which has some very meritorious points. With this form of dynamometer some very good work was done at the Frankfort Electrical Exhibition last year, and it was due largely to this piece of apparatus that certain power tests of generators and electric motors of German manufacture were successfully made at that exhibition.

The writer has seen a number of these dynamometers in their daily operation in machine factories abroad, and was agreeably surprised to note the convenience and despatch with which the measurements of widely different types of machines could be made with the same comparatively simple apparatus.

The credit for the design and construction of this dynamometer is due to Mr. Fischinger, chief engineer of O. L. Kummer and Co., and its construction and application is as follows:—

A continuous, partly hollow shaft *a* (Fig. 1) runs in the journals $o\ o_1$ (Figs. 1, 2, and 3) of the frame *p*. The three arms *d d e* form one piece with the shaft, and stand out from it at right angles. The smaller shaft *i* with the lever arm *g* has its one bearing in the enlarged portion of the main shaft, its upper end running on a pin of the arm *d*. This upper end of the shaft *i* carries a lever of the first class *k*. The two arms of the latter engage with two projections $n\ n_1$ and $v\ v_1$, cast on the inside faces of the

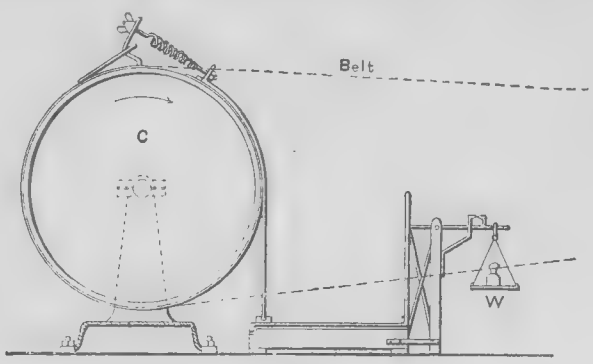


Fig. 6.

pulleys *c* and *c* (Fig. 3). On a pin at the extreme end of arm *e* turns the double lever *f f*. A pin at the end of arm *f* runs in a slot g_1 of the lever arm *g*. The outer end of this arm *g* carries two threaded pins with adjusting nuts *h h*. To avoid sudden shocks when the dynamometer is set in motion, these two adjusting nuts strike against two rubber cushions on the inside faces of the two pulleys. The arm *d* has a long slot in which runs the bolt *m* carrying a weight *e'*.

* By R. O. Heinrich, in the "Electrical World."

By a proper adjustment of this weight the centre of gravity of the whole lever system can be brought to coincidence with the centre of the main shaft a a.

A rod b runs through the centre of the hollow part of shaft a. This rod b pushes with one end against the end of the lever arm f, while the other end touches the arm r of lever r r. An adjustable weight v serves to balance the weight of arm r. The lever r r turns around the pin t; the arm r, which ends in a sharp point, can move over a scale t at the lower end of the frame.

The whole system of levers is enclosed between the two movable pulleys c c_1; it is, however, very easily accessible by loosening the collar a_2 and shifting the pulley c_1 towards o.

The action of this dynamometer is as follows:—The power is transmitted from the power generator by a belt to the pulley c_1 (Fig. 4), by means of the lever k k_1 to the pulley c, and from this pulley by another belt to the machine under test. The rotary motion is therefore transmitted from one pulley to the other by the lever k k_1 and shaft i. But since the two pulleys are loose on the shaft they will tend to shift their position relatively to each other. This amount of shifting is communicated by the lever k k_1 to shaft and lever arm g_1, thence to the double lever f f_1. The end of the lever f f_1 pushes against the rod b, and this in turn against arm r_1 of lever r r_1. The tendency to shift between the two pulleys is therefore indicated by the index f_1 on the scale t_1.

In order to find the force which tries to turn the lever k, k_1 about its fulcrum i, weights are placed in the scale pan at the end of lever arm r until the index r_1 returns to zero, in which case the system is in equilibrium. The levers have such position relative to each other that the forces transmitted through them all act perpendicularly to the arms, thus allowing the relations between them to be easily calculated. The ratio of the weights on the scale pan to the pull on the circumference of the pulley depends upon the ratio of the lever arms. This ratio is made 10 to 1; the pull on the circumference is therefore ten times the weight in the scale pan. It must be taken into consideration, however, that in this case the weight in the scale pan will indicate the total work done, including that which it takes to run the dynamometer without a load. The weight corresponding to this latter amount of work will, of course, differ for different velocities, and can very easily be determined by throwing off the belt from the driven pulley, and by balancing the system when running at the new velocity which is desired for a certain test. By making records of the different balancing weight for different velocities this can be kept in the form of a table for future references. The diagram (Fig. 5) shows the system of levers, which can easily be measured with great accuracy. To determine the proper point of suspension X of the scale pan, the lengths of the different lever arms are accurately measured, and the point x found by calculation.

If P = force acting on the circumference of the driven pulley,

R = radius of the pulleys,

R_1 = distance of lever K from centre of shaft a,

K, g, f f_1, r r_1, lengths of respective lever arms,

W = weight on scale pan,

we shall have the equations

$$P \times 2R = P_1 \times R_1$$

$$(1) \qquad P_1 = \frac{P \times 2R}{R_1},$$

$$P_1 \times k \times f_1 \times r_1 = W \times r \times f \times g,$$

$$(2) \quad r = \frac{P_1 k f_1 r_1}{W r f g} = \frac{2 P R k f_1 r_1}{W R_1 r f g} \text{ and since } \frac{P}{W} = 10$$

$$(3) \qquad r = 2 \times 10 \frac{R}{R_1} \times \frac{k}{g} \times \frac{f_1}{f} \times \frac{r_1}{r}.$$

The calculation may be checked by the arrangement shown in Fig. 6.

A brake frame is fastened on the face of the driven pulley. A projection on the brake frame pushes down the rod r when the pulley rotates in the direction indicated by the arrow. This rod presses against the platform of a decimal scale, and the pressure on the platform is counterbalanced by a weight W, which must be equal to the balancing weight on the scale pan of the dynamometer, if this is suspended in the proper point.

For a convenient calculation of the applied or consumed force in horse-powers, the pulleys are given such diameters that their circumferences are expressed by even numbers. The following table gives some of the consonants of five different types of the dynamometer:—

	I.	II.	III.	IV.	V.
Circumference of pulleys in metres	1·5	2	3	3·5	4
Maximum load on scale pan in kilogrammes	6·0	12·0	22 0	50 0	75·0
Maximum number of revolutions per minute	1200	900	600	510	450
Maximum number of H.P. at a circumferential velocity of 30 metres per second	24	48	88	200	300

The maximum capacity of any type is reached when, with the greatest number of revolutions, the scale pan carries the greatest admissible weight. For type number I., which with a circumference of the pulleys of 1·5 metre is built for a maximum number of revolutions of 1200 per minute and a maximum load on the scale pan of 6 kilos., the maximum reading would be as follows:—

$$\text{Velocity of the belt } \frac{1200 \times 1{\cdot}5}{60} = 30 \text{ metres}$$

per second. The force acting on the circumference of the driving pulley = 6 × 10 = 60 kilos., and the maximum horse-power which can be measured $\frac{30 \times 60}{75} = 24$ H.P. (metric).

Current Strength in Ampères.	E. M. F. in Volts.	No. of Revolutions of Dynamo.	Velocity of Belt per second = v.	Pull on Belt in kilogrammes = k.	Horse-power H.P. = $\frac{v.\ k.}{75}$
215	65	830	15·1	122	21·6
158	68·5	850	15·5	96·5	19·9
103	70·5	870	15·75	71·0	14·9
31	74·0	875	16·1	34·5	7·4
0	75·0	885	16·25	17 5	3·8
0	2·5	890	16·25	6	1·3
215	63·0	840	15·75	14·1	29·5
0	67·0	835	15·25	11·5	2·35

Since the maximum reading of the dynamometer is in direct ratio to the number of revolutions, if the force acting on the pulley is the same, the number of horse-powers that could be measured with only 200 revolutions per minute would be:—

$$\frac{24 \times 200}{1200} = 4 \text{H.P.}$$

The most prominent advantages of this dynamometer are the following:—

The use of springs is entirely avoided, and a change of the centrifugal force cannot influence the result of the measurements.

Great sensitiveness obtained by proper balancing, and minimum friction in the lever system accomplished by the use of knife-edges wherever possible.

Simplified calculations show the dynamometer is constructed on the principle of the decimal scale.

The most recommendable feature of this dynamometer is its extremely large range. The largest model is sensitive from a fraction of a horse-power up to its fullest capacity. The above table of measurements of a dynamo made with a No. III. dynamometer (for 88 H.P. maximum) proves this conclusively.

Automatic registering devices may easily be combined with the dynamometer, making it a still more useful piece of apparatus for the every-day routine work of machine shops and dynamo factories, all of which combined with the other prominent advantages should make the dynamometer a desirable adjunct for every factory or laboratory where power tests are of frequent occurrence.

In February, 1891, a French Parliamentary Commission advised the establishment of a labour bureau "to collect and publish information concerning the conditions of labour, the relations between labour and capital, the hours of labour, and the wages of the working classes." The bureau began work last October. It has a permanent staff of 28, and the right to employ, in addition, special temporary delegates. It is proposed to issue a monthly bulletin, as well as special reports of particular subjects.

Intuition in Machine Designing.*

THERE is no part of the extended field of mechanical engineering which calls for the exercise of mechanical intuition and inventive capacity to such an extent as machine designing. There is scarcely a machine of any kind conceivable that may not be designed in a great variety of ways such that it may perform its functions or subserve its purpose more or less perfectly; while its efficiency, cost, durability and fitness in every way will be as various as these possible designs. It is the intuitional mechanic that will evolve the best design in a vast majority of cases rather than the man who is expert in the higher analysis, and there are few experienced mechanical engineers who are competent machine designers who will not bear me out in saying that a very large proportion of machines never require the aid of the calculus to give them their best and most efficient design and proportions, and that the application of that powerful instrument could not be of much, if any, effect in bringing them as near as possible to perfection.

Machine designing forms so important and extended a part of the profession that what would seem to be most needed in mechanical engineering schools is a more definitely marked-out course in that particular branch. The course in mechanical drawing, now constituting a definite part of the curriculum, should, of course, be an adjunct of this branch—and a principal one,—but only an adjunct; while what should really be prominently a course in machine designing should include in a more or less extended way what the name implies. In such a course, machines and parts of machines should really be designed, and the same part or machine be designed in various competitive ways.

There is, of course, no end to the extent to which this might be carried, quite to the detriment of the boy's more fundamental and general instruction; but exactly the other extreme is now pursued in paying too little attention or giving an insufficient prominence to the development of the mechanician, and in consuming too great a proportion of his college period in refinements of the more general studies which he can very much better dispense with at the outset of his career in practical life and more easily acquire afterwards, than he can do without that which calls for the exercise of his executive and constructive capacity at the start.

The present system leaves the young man at graduation as an "M. E." in such position that, in a majority of his possible fields of activity, little is to be hoped for from him in earning capacity (and for a large number of our young men this is a very serious matter), and is dooming many promising men, really capable of better things and deserving of better prospects, to a long period of subaltern drudgery, which disappoints and discourages them to the last degree.

The kinematics of machines, as given in the text-books now in use in the schools, constitute a valuable branch of general study in the direction of development of mechanical intuition; but this kind of study of mechanical movements is too general in character to operate definitely in the direction of educating the inventive or mechanical bent, unaided by the more specific study of and exercise in constructive problems.

Shop practice and instruction as now pursued is of the last importance; but it takes hold of the problem at the extreme practical end only. It imparts an indispensable kind of instruction, to be acquired in no other way so well, and one which no mechanical engineering student should have less of than he now obtains at those institutions; but between this and text-books kinematics—as particularly pertinent to machine designing—lies the missing link which is wanting in the undergraduate courses.

The study of kinematics as now taught is as essential in the course as either of the other fundamental branches, and shop practice, within the limits of the school period—while far from making a skilled mechanic of a man,—teaches him how the principal operations in the shop are best performed; but a proficiency in both of these, added to the various fundamental parts of his general curriculum, still leaves him—particularly as a machine designer and executive engineer—without the ability to play such a part therein as should reasonably be looked for in a graduate. It should be a part of his curriculum to design some machines, and invent others, in a competitive manner, such as might be expected to properly subserve some predetermined purpose.

*Abstract of an article by John J. Hawkins in the "Engineering Magazine."

Some Points for the Electrical Engineer.†

ALTHOUGH it is the province of this institute to consider largely the more theoretical side of electrical engineering, and rightly so, it is perhaps well that it should occasionally have brought to its attention that outside practical part, only for which theory would have no backing, and therefore could not reach its proper development.

It has been the fortune of the writer during the last ten months to visit and inspect, both technically and financially, considerably more than a hundred central lighting stations.

Taken as a whole, it really seems as if much of the ordinary commercial common sense and the usual keen judgment of self-interest had been on a vacation when these plants were erected. In many cases this traces back—first, to the wiles of that slickest of all individuals, the agent, who is always willing to assure the buyers that his system of lighting will virtually run itself, and then to the fact that people were formerly so doubtful of the prospective profits that on going into the business they invested the smallest amount that would start the work. The consequence was, bad construction, bad machinery, bad lines, and, of course, an entirely unreliable service. Oftentimes the man put in charge was a novice, and that worst of all novices for the business, the local amateur electrician; and is it any wonder that the business was a failure for the first few years?

In some localities this condition still obtains, nothing having been done but to patch up the bad work of the past.

In a few cases the administration has been changed by putting at the head some substantial and tried business man, very much to the benefit of the concern, while in many instances even the large city plants suffer from the above causes; they also suffer from other conditions inherent in the size of their field.

The pioneers were so timid about the outcome that the city station was invariably very much too small, and inside of two years had become so patched up and crowded that rebuilding became necessary; and this in many cases was repeated two or three times.

There is probably no business extant which has been built over again so many times, and that has had the same quality and quantity of brains applied to it, that is in such chaos as to the proper design of building and arrangement of machinery. In cotton or any other weaving industry, machine shops, foundries, and similar establishments, it has long been determined which is the best form of building to erect, and those put up in the last ten years or so of a similar industry are planned on the same lines, differing only in size to suit the special case. Now this not only fails to be the case in electric lighting, for outside of the two prominent systems of connecting the dynamo to its power—that is, by direct belting to fast running engines, or by counter shaft to larger slow running engines—there are scarcely half-a-dozen stations built on the same or similar lines.

So much diversity of opinion is shown in designing these stations, and oftentimes by those whose opinion should have no weight, but unfortunately does, that it has the effect to convince some of the investing public that the electrical engineer does not know his business, and that they might as well attend to it themselves.

If some action could be taken by this institute through a committee which should examine into proper station design and report on some few general plans and suggestions as to lines to be followed, it might go far towards establishing a better backing for our members who are in that branch. As it is, I think it will be acknowledged that far more electrical engineering skill is applied to the larger isolated plants, and that the central stations are enlarged or rebuilt under the management of the local superintendent or board of directors, who frequently lack technical knowledge or even familiarity with recent improvements elsewhere. Quite often this is owing to the fact that the only experience they have had with an electrician has been with the generally young inexperienced expert who was sent out to install the first plant, and they think they can make better use of their money by controlling it themselves.

The method of distribution should also have consideration, especially in reference to the amount and style of underground work which certain sizes of city will be able to stand.

This may seem a large question, but you can be assured it is one of the most vital

† A paper, by H. A. Foster, read before the American Institute of Electrical Engineers.

to the future welfare of the industry. It may be said that it is not well to interfere in private business, and that electrical engineers can be trusted to remedy the evil. I assure you the electrical engineer individually "is not in it," to use a vulgar phrase, and, sad to say, has never been in it to any extent. Quite often officials of the electric lighting companies take a jaunt through the country, visiting different stations for models for a new one for themselves. This often results in a worse muddle than ever, as they seldom find two stations at all similar, and they return resolved to use their own judgment.

This leaves the real electrical engineer out in the cold, at a point where if known he could by consultation do much good; but many of these company officials never heard of the American Institute of Electrical Engineers, and need to have it brought to their notice in some way.

Some may think that in time the electrical engineer will be called in and consulted, as are engineers of other works; but at the present rate I am afraid many will be angels or worse before the majority of electrical central station companies come to that point.

Perhaps if instances be mentioned under the following heads a better understanding may be arrived at:—Location; foundations; construction of station; motive power; arrangement of machinery, and location and construction of lines.

Location.—The location of plants is not now so generally bad as in the past, although we occasionally find a station in a location for which no excuse is apparent, as, for instance, one located in the basement of a carpenter's shop at a long distance from fuel supplies, and only plenty of condensing water to recommend it; insurance rate, 3 per cent. or more. Another located nine miles away from a village of two thousand people, to take advantage of water power never surely available all the year, and since destroyed entirely for the greater part of the year. Another placed so low down in reference to its water power as to be flooded in freshets. Another located more than a mile from fuel supplies, and the centre of distribution at the top of a long steep hill, with not even free water to recommend it. Another so located in relation to a very intermittent water power as to be unable to take advantage of the water for condensing purposes, and now running the poorest kind of a slide-valve engine. Another located in a rickety, old, uncared-for part of a gashouse where coke is scarce, and apparently plenty of water power available within half-a-mile. Another located a long distance from the centre of distribution and coal supplies, to take advantage of cheap land and cheap fuel, the last of which has since proved very unreliable, when seemingly land could have been had much more central, with a much surer supply of cheap fuel, and, to cap all, the value of that land has since increased enough to have paid the entire cost of the station at any moment it was desirable to sell.

One advantage of some of the older centrally-located stations has since been learned in the increase in value of such real estate. One such station visited will enlarge and rebuild soon, and will sell its present real estate for enough advance to go far towards paying for the new station; and there are others which can, I think, tell the same story. In fact, in the present problematical growth of the future, a well selected piece of ground may prove a very valuable part of the investment.

Foundations. — Foundations are now much better than in the past, and some of those now placed under dynamos would sustain almost anything that could be put on them. Poor foundations are occasionally seen, though, as for instance those under a large bank of boilers in a station which was erected and started in six weeks. The boilers have since lurched forward until the fronts are some 2in. or 3in. out of plumb. In fact, too little attention seems to have been paid to boiler foundations as a general thing.

Engines have fared better, and when the ground has been good the foundations are to be little criticised.

One station has very large Corliss engines, and owing to water-soaked ground and limited time in which to build the brick foundations, they were placed wholly above the floor level of the dynamo-room, and belts run both ways from the fly-wheels to shafting on either side of the room.

Very few bad dynamo foundations are now met with, but many unbalanced armatures are found which no amount of foundation would hold steady.

(To be continued.)

THE Pullman's Car Company have declared the regular quarterly dividend of 2 per cent.

Experiments on the Overheating of Steam Boilers.*

THE author relates the results of various experiments undertaken to determine the cause of overheating in boilers. A boiler is said to have been overheated when the boiler plate has become red hot at any given spot, and the phenomenon is recognised by the bluish shade the iron assumes when cold, due to the formation of a layer of oxide. Overheating alters the quality of the metal and disintegrates the joints, and unless at once detected and remedied it ultimately results in an explosion. Hence it is the source of much anxiety, and various attempts have been made to account for it. The reason generally assigned, an insufficient supply of feed-water, cannot be accepted as a full explanation, for cases have occurred in which a boiler has become overheated when full of water. It was to contribute to the solution of this intricate, but most important question, that the author made the experiments here recorded.

The fundamental principle on which a boiler is constructed is to serve as a vehicle for the transmission of heat. Overheating differs in its intensity, but not in its nature, from the ordinary phenomena of the passage of heat through metal. In a boiler the iron plate has water on one side, and on the other the heat from the furnace, which acts upon it by radiation and contact. Before reaching the water this heat has three obstacles to surmount. (1.) It enters the metal through its exterior surface, acting through what is called its external conductivity. (2.) It penetrates the thickness of the boiler plate, bringing into play its internal conductivity. (3.) It passes from the interior surface of the metal to the water, acting again through the external conductivity of the metal. These three phases of the exchanges of heat between the flame and the water have already been the subject of many researches. Heat is more rapidly communicated to a fluid than to a gas. Therefore in the wall of a boiler the surface in contact with the water will have almost the same temperature, while the opposite surface will be much cooler than the gases or flames impinging on it. Heat is easily transmitted through the metal, unless there is any flaw in it, or extra thickness, as of a joint; but an incrustation or layer of grease interposed between the surface of the metal and the water checks the natural flow of the heat, and any of these causes, by arresting the heat in its passage from the furnace to the water, may lead to overheating.

Before considering the causes of the phenomenon, the intensity of the flow of heat through the boiler plate at its hottest part ought, if possible, to be ascertained, and it was to the elucidation of this point that the author's first experiments were directed. He divides the subject under three heads. (I.) The evaporative power of a boiler in the vicinity of the part where overheating usually occurs. (II.) The transmission of heat through the metal, and from the metal to the boiler. (III.) The especial influence of a layer of grease on the heat conductivity of the coated surface.

(I.) In calculating the evaporative capacity of boilers, it is usual to reckon it at so many pounds per sq. ft. of heating surface. But the author is of opinion that this method is not sufficiently accurate to determine the maximum evaporation at any given point, since evaporation is not and cannot be uniform throughout a boiler. A boiler becomes overheated at its hottest part—that is, the part subjected to the greatest heat, and the largest quantity of water will be here evaporated. To study the phenomena of overheating, the effects of heat at this particular part, and the amount of evaporation from it, must be determined. The author, therefore, isolated a portion of a boiler plate immediately above the bridge, where the heat is known to be greatest and overheating most frequently takes place. He placed upon it a small vertical iron tube, which was firmly bolted to the bottom of the boiler; the top of the tube rose above the level of the water, and opened into the reservoir of steam. The tube was fed through a separate pipe with water at the same temperature as that in the rest of the boiler, and the quantity of water evaporated by this limited area of heating surface was carefully measured.

The experiment was made on a cylindrical boiler, with four separate lateral feed-water heaters, of which a sketch is given in the original paper. The boiler was 10ft. long, and 2ft. 2in. in diameter, with a heating surface of 35¼sq. ft.; heating surface of the feed heaters, 107½sq. ft.; total, 142¾sq. ft. The grate surface was 3·85sq. ft., and a blower increased the draught when a stronger fire was required. The small experimental tube was 4in. diameter, with a heating surface of 19·3sq. in., bolted to the boiler, and the joint made with asbestos and indiarubber. The tube was connected to the water gauge of the boiler, and the same level of water maintained in both. Previous to an experiment the boiler was heated for several hours, and communication was then cut off between it and the experimental tube. During the trials the pressure in the boiler was kept at about 60lb. The fire was stoked as usual, the consumption of coal noted, and the total evaporative power of the boiler determined.

In the original paper the results of the experiments are summed up in a table, showing the total consumption of coal and water, the consumption of coal per hour per sq. ft. of heating surface, and the corresponding evaporation of water from the boiler, the feed-water heaters, and the tube which covered the portion most liable to overheating. With different intensities of fire the consumption of coal per hour per sq. ft. of grate varied from 16lb. to 48lb. The author, however, does not advocate such excessive duty, and considers that any consumption of coal above 30lb. per sq. ft. of grate represents a rate of firing inconsistent with the safety of the boiler. As a rule with stationary boilers having the above proportions of heating to grate surface, from 1·6lb. to 2·4lb. of water are evaporated per hour per sq. ft. of total heating surface. Here the maximum evaporation was 9·4lb., and the minimum 1·9lb., or from two to four times as much as in a locomotive boiler. Evaporation was extremely active from the portion of the boiler surface covered by the tube, varying from 20lb. to 49lb. of water per hour per sq. ft. of heating surface with moderate firing, and from 40lb. to 48lb. with strong firing. The forced draught increased combustion but not evaporation. The author concludes that, with stationary boilers working under ordinary conditions, evaporation at the part most exposed to overheating ought not to exceed 20lb. to 28lb. of water per sq. ft. of heating surface per hour, and never attains 50lb. in practice.

(II.) Having thus determined the intensity of the heat transmitted from the fire to the outer surface of the metal, the author proceeds to examine the second branch of his subject—the propagation of the heat through the metal, and from the metal to the water. It is comparatively easy to gauge the extent of the flow of heat through a boiler plate, but when the boiler is at work the abnormal conditions of temperature under which it is liable to become overheated cannot be studied. To realise them as far as possible, the author was obliged to abandon the steam boiler hitherto used, and to carry out his experiments on a small apparatus specially constructed for the purpose, a drawing of which is given in the paper. A circular piece of boiler plate ⅝in. thick, 15·7in. diameter, was exposed to a strong flame on one side, and covered with water on the other. The quantity of heat passing through the plate evaporating the water, and the temperatures of the iron on the side next the fire, were carefully measured. To generate the heat a small experimental furnace was constructed in the following manner:—

The circular piece of boiler plate was placed over a kind of crucible, lined with fireclay, with a pipe at the bottom, through which a jet of gas was fed with compressed air from a little pump like a blowpipe. The upper edge of the crucible was about ⅝in. distant from the plate, and was encircled by a second outer casing of fireclay, which served the double purpose of concentrating the heat and limiting the portion of the boiler plate subject to it. The flame was allowed to play between the crucible and the bottom of the plate. To measure the heat passing from the flame through the iron plate a small copper cylinder was placed upon and solidly jointed to the plate, the two forming a miniature experimental open boiler, in which a water level was always maintained. The quantity of water evaporated at atmospheric pressure from this apparatus gave the measure of the quantity of heat passing through the iron plate. The top of the little boiler was surmounted by a conical cover, a small space being left between them through which the steam escaped, while the rim of the cover caught the condensed water, thus forming a kind of jacket. Distilled water was used from a large vessel, from whence it passed into a glass bottle, with a scale for gauging the quantity. By this arrangement the level of water in the boiler was uniform.

(To be continued.)

* Inst. C. E.: Foreign Abstracts.

MESSRS. A. DAVIES AND CO. are contemplating the erection of new metal stamping works in the Marshes-road, Newport, Monmouthshire.

Metal Trade Memoranda.

A vein of zinc has been discovered near Schreiber, Ontario. It is from 30ft. to 40ft. wide. An assay is said to have given 50 per cent. of zinc.

Tests recently made at Cornell University show that aluminium has no very marked influence upon the magnetic conductivity of cast iron, and but slightly decreases its permeability.

A trial of a nickel armour plate 17in. thick is the next important event in ordnance matters to take place in the United States. This armour, which is now being completed by the Bethlehem Ironworks, is the thickest ever manufactured in the States. It is the trial plate for the turret armour of the "Indiana" class of battleships.

Professor Beilatein, of St. Petersburg, has recently discovered a new method of separating alumina and oxide of iron. The mixture is dissolved in nitric acid, and the solution evaporated to dryness in a water bath. The residue is heated until all smell of nitric acid disappears, and is then placed in boiling water and boiled. Then a few drops of sulphate of ammonia are added, and the solution is filtered. The alumina passes through the filter as basic nitrate, but the iron remains behind as an insoluble sub-nitrate.

Herr Carl Friedrich, a German geologist, has been prospecting for two years in a mineral belt, 100 miles from Cheyenne, Wyoming. Recently Herr Friedrich made a favourable report to the local agent of his Berlin employers. He says that he has struck a deposit of nickel and cobalt "that in richness and extent will surprise the mining world." The find is 40ft. under the surface, and beneath 30ft. of iron. Fourteen shafts have been sunk in the beds. The vein of nickel and accompanying cobalt is said to be 14ft. in thickness, and the assays are reported to be highly satisfactory.

The directors of the Tinsley Rolling Mills Company Limited, in their annual report, issued on the 22nd inst., state that, notwithstanding the adverse influences which have affected the trade of the town during the past year, a profit of £2228 13s. 3d. (including £61 15s. 9d. brought forward from last year) has been made on the year's trading, a result which the directors do not doubt will be satisfactory to the shareholders. The directors recommend that a dividend of 2½s. per share be declared, free of income tax, which will absorb £1800, and that £428 13s. 3d., the balance, be carried forward to next year's account.

The cobalt deposits in the vicinity of Dashkesan, in Southern Elisewetpol, have been exploited for about a year and a half. Recent investigations prove the existence of a number of parallel veins in the same tract of land which carry in groups a smaltine or grey cobalt of great purity. The new find thus demonstrates the correctness of the assertion of the late M. Bernouilli to the effect that the cobalt wealth of the Dashkesan hills would be found to exceed that of any other district. The first adit was opened in the autumn of 1890 in the elevation bounded by the ravines of the Tchalunz and Tutunz streams, and by the time it had reached a length of 65ft. it had yielded 90 tons of ore. A sinking made at the entrance to the adit, with the view of making another gallery some 35ft. under the first, yielded lately 14 tons of pure ore.

The experiments conducted by the Admiralty of Sebastopol, Russia, on the malleable cast iron of the Sestroretzk Ironworks have given very important results. The trial bars of Sestroretzk iron, which had a cross section of 1·53 to 1·54in. by 0·3in., equal to 0·459 to 0·462 sq. in., broke with a tension load of 9·69 to 9·75 tons after an elongation of 0·125in., which is equivalent to a tensile strength of 21·1 tons per sq. in. cross section. These figures compare well with ordinary Siemens-Martin steel, which has a tensile strength of 21·6 to 22·2 tons per sq. in. One of these bars heated to red heat was folded and refolded several times in succession, and at the end only one, scarcely perceptible crack showed, and it could still be easily folded. A second bar, folded cold under hydraulic pressure, after taking a persistent curve, finally broke. A third bar heated to cherry red could be forged and lengthened into strips.

Trade Marks.

The following is the Official List of Applications published from July 13 to July 20, for the Registration of Trade Marks, so far as relates to the Metal Trades.

CLASS 6.

"The essential particular of the Trade Mark is the following device, and I disclaim any right to the exclusive use of the added matter."

165,345. Machinery of all kinds and parts of machinery, except agricultural and horticultural machines. JOSEPH THOMPSON PICKERING, 63, Queen Victoria-street, London, E.C.; engineer.—10th June, 1892.

CLASS 12.

163,892. Electric bells. BAXENDALE AND CO., 51, Miller-street, Manchester; manufacturers.—31st March, 1892.

CLASS 50.

"The essential particular of the Trade Mark is the device, and the applicant disclaims any right to the exclusive use of the added matter."

161,231. Engine packing. JOHN HENRY DEWHURST, 70, Attercliffe-road, Sheffield; consulting engineer and mill furnisher.—14th April, 1892.

CLASS 50.

ESME

165,419. Metallic packing. HULBURD BROS. AND CO., 150, Leadenhall-street, London; railway supply contractors and patentees.—11th June, 1892.

The Official Gazette.

Partnerships Dissolved.

HAWORTH AND HARTLEY, Haslingden, ironfounders.

G. R. ALSTON AND YOUNGER, Queen Victoria-street, E.C., civil and mechanical and brewery engineers.

BRUNTON AND TRIER, Great George-street, Westminster, civil engineers; as far as regards J. D. Brunton.

THE BANKRUPTCY ACTS, 1883 AND 1890.

Adjudications.

JOHN HENRY HAWKESFORD AND ALFRED HAWKESFORD (trading as J. H. and A. Hawkesford), Birmingham, tinplate workers.

WILLIAM HESKETH, Manchester, ironfounder.

CHARLES INWOOD, Milton-next-Gravesend, Kent, engineer, millwright, and general smith.

Commercial Gazette.

☞ The name given is that of the defendant; the amount is that for which judgment was given, and the date is that on which it was given.

County Court Judgment.

STEWART AND HAUFF, trading as The Metal Stamping Company, 50, Pentonville-road, stampers, £15 6s. 11d. 27th June.

New Companies.

UNIVERSAL ARC LAMP SYNDICATE LIMITED.—This company was registered on the 16th inst., with a capital of £3000, in £1 shares, to acquire, develop, and turn to account a certain invention for improvements in electric arc lamps for which a patent was applied for on April 13, 1891 (provisional specification No. 7095, of 1892), and to carry on the business of electricians, mechanical engineers, manufacturers of and dealers in electric lamps and other apparatus, and suppliers of electricity. The number of directors is not to be less than three nor more than five, the first being Messrs. C. H. Freedman, F. W. Suter, and A. R. Carter. Registered by Messrs. Valpy, Chaplin and Peckham, 19, Lincoln's Inn Fields, W.C.

STEEL RAILWAY JOURNAL-BOX CO. LIMITED.—This company was registered on the 20th inst., with a capital of £120,000, in £1 shares, to acquire and purchase from "The Patent Stamped Steel Railway Axle-box Co. Limited" certain letters patent for axle boxes and covers, and the plant and machinery for working such patents, particulars of which are specified in the agreement mentioned in clause 1 of the articles; to enter into the said agreemnt (with the old company), and to develop and turn to account the said patents. The number of directors is not to be less than three nor more than five, the first being Messrs. J. Allen, J. M. Brotherton, F. Hargreaves, and P. Hargreaves; qualification, 200 shares; remuneration to be fixed by the company in general meeting. Registered by Messrs, Foss and Ledsam, 3, Abchurch-lane, E.C.

THE manufacturers of railway carriages find little employment from the home railways, and are still suffering from the South American collapse. There is no disposition at present to spend money in advance of traffic requirements; but the mileage of existing railways abroad and in the colonies, which depend on this country for their supplies, is great enough to ensure regular though moderate employment for the factories here. Carriages and wagons, mostly with metallic underframes, continue to be exported for the Indian railways. At home there has been a great demand for coal and mineral wagons, and makers of wheels, axles, and other subsidiary parts have been busy accordingly.

Letters to the Editor.

*** *We do not hold ourselves responsible for opinions expressed by correspondents.*

*** *The name and address of the writer (not necessarily for publication) must in all cases accompany letters intended for insertion, or containing queries.*

*** *Letters intended for publication in the current week's issue must reach our Manchester Office not later than by the first post on the Tuesday preceding the date of publication.*

CONICAL TANK.

To the Editor of THE MECHANICAL WORLD.

SIR,—It seems that Mr. William Cox knows very little of algebraic calculations, or he would not state that only two diameters—D=27in. and d=11in.—can be found which suit the formula $D^2+d^2+Dd=1147$. On the contrary, there are any number of such diameters. For instance, the two diameters, D=24·2in. and 14·52in., found by E. Gobert and by the writer, which, approaching the ratio 5 : 3 and substituted in the above formula, will give 1147.

Let us take Mr. Cox's formula. Contents in ale gallons

$$=\frac{H\times(D^2+d^2+Dd)\times 0{\cdot}2618}{277{\cdot}27}$$

and substitute the following quantities:—D=24·2in., d=14·52in., H=12in. Contents in ale gallons

$$=\frac{12\times(24{\cdot}2^2+14{\cdot}52^2+24{\cdot}2\times 14{\cdot}52)\times 0{\cdot}2618}{277{\cdot}27}$$

=13.

"Mechanic" cannot fail if he takes D=24·2in. and d=14·52in.; these are the only two diameters with the ratio of 5 to 3 which will form with a depth of 12in. a conical tank with a capacity of 13 ale gallons. H. ST.

Landore, July 23.

Miscellaneous Items.

It is stated that there is a lighthouse to every 14 miles of coast in England, to every 34 in Ireland, and to every 39 in Scotland.

The question as to the adoption of the electric light on the North Baltic Canal in Germany is at present under consideration.

A rich vein of coal is reported to have been discovered at Eccleshill, near Darwen. It is 28in. thick, and is said to be of very fine quality.

There are now two English steamers on the Zambesi carrying up general goods and passengers, and bringing down ivory, coffee, and oil seeds.

The lighthouse highest above the sea level is the one at Point Loma, at the entrance of San Diego Bay, California, 462ft. above the ocean.

Experiments have been made by the London police force with small electric lamps in place of the oil lanterns now in use. So far, it is understood, the new venture has proved highly satisfactory. Each lamp weighs 4oz., and gives a continuous light for seven hours.

Mr. Thomas Brunton was on the 19th inst. appointed general manager and interim secretary of the Glasgow and South-Western Railway Company, in room of the late Mr. Morton. Mr. Brunton entered the service of the Company forty years ago, and for some years past he has been the company's solicitor.

In 1891 there were open 1666 miles of railway in South Australia, the net revenue of which was £606,820, or 5·32 on the capital (£11,398,839) cost of the railways open. This amount goes in reduction of the general interest of the debt of the colony, the balance only being drawn from the consolidated revenue of South Australia.

The dry dock which is being built by the Russians at Vladivostock, their port on the east coast of Siberia, will be one of the largest in the world. It will have a length of 550ft., a breadth of 120ft., and a depth of 30ft. In length it is only surpassed by the dry docks of Portsmouth, Halifax (Nova Scotia), and Hong Kong; in breadth only by that of Saigon.

Locomotives at the Paris Exposition in 1889 formed the subject of a note recently contributed to the French Society of Civil Engineers by M. Polonceau. It was stated that towards the close of 1889 a special committee was appointed to report upon the locomotives exhibited at Paris during that year. This report has just been completed, and in submitting it to the society M. Polonceau explained that it consisted of four main parts, the first of which gives a full account of the French locomotives of standard-gauge, with tables of dimensions, etc. The second part similarly relates to foreign standard-gauge locomotives; the third gives descriptions of both French and foreign narrow-gauge locomotives, engines for rack roads, motor cars for steam street railroads, and embraces also the exhibits in the line of electric traction; and the fourth part goes into a comparison of the various standard-gauge French locomotives shown. The whole report is said to be exceptionally thorough and exhaustive, and correspondingly valuable.

During the month of June, Chili imported from Great Britain 2635 tons of railway material, 221 tons of hoops, plates, and sheets, and 495 tons of galvanised sheets, as compared with 534 tons, 129 tons, and 76 tons respectively in June, 1891.

A compound magnetometer for testing the magnetic properties of iron and steel has been invented. An aluminium wire, 30in. long, suspended vertically by a fibre, carries at the top a magnet fixed at right angles to the wire. The lower end carries a light fork, across which a fibre is stretched horizontally. A mirror attached to this fibre carries a magnet at right angles to the fibre. The mirror is thus capable of two independent motions. The specimen of iron is placed in a magnetising coil near the mirror, and the magnetising current passes also round a coil placed near the upper magnet. The motion of the mirror is observed by the aid of a spot of light. On gradually increasing and diminishing the current, the spot traces out curves of magnetic variation.

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Queries.

☞ Readers are invited to avail themselves of this section for practical information on questions relating to Mechanical Engineering and the Scientific Industries.

☞ Queries and Replies should arrive at the Manchester Office not later than by the first post on the Tuesday preceding the date of publication.

MAKERS OF CELLULOID.—Required the names and addresses of extensive makers of celluloid.—B. P.

NICKEL.—In an alloy of cast iron and nickel what is the increase in strength over cast iron, and what proportion of nickel should be used?—T. C.

ALUMINIUM.—Will any reader inform me what is the greatest percentage of metal alumina has been found to contain up to the present date?—ALUMINA.

ECONOMISER SCRAPERS.—What means must I adopt to renew some broken scrapers in the middle of the range of pipes in the economisers?—PUZZLED.

PATTERNMAKER'S TOOL BOX.—Will any reader give me a sketch of the patternmaker's tool box, with full dimensions and particulars?—APPRENTICE.

CRUCIBLE.—Will any reader inform me how plumbago crucibles are made for melting brass and steel; also sketch of machine for making same?—PLUMB.

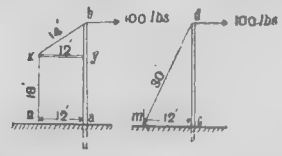
RIFLING MACHINE.—I should be glad of a sketch of any appliance used for rifling out small barrels, such as revolvers, etc., say ¼in. to ⅜in. bore, with threads, say, 6in. pitch.—NEMO.

FRICTION OF WATER IN PIPES.—What is the head of water in feet necessary to overcome the friction of a bend 10in. bore and 12in. radius; velocity of water, 170ft. per minute?—VULCAN.

HOT-AIR ENGINE.—Will some reader of THE MECHANICAL WORLD kindly oblige me with a section and principal dimensions of a ½H.P. single-acting hot-air engine of the Stirling cycle?—GEO. H. PERKINS, North Queensland.

HEAD-GEAR FOR COLLIERY.—I have contracted to make a pitch pine head-gear for a colliery. The pitch pine is 16in. square, and the head-gear is to be 35ft. high; also, it has to be placed on either brick or stone pillars 15ft. high. Can anyone inform me of a good plan to get it to the top of these pillars, or will someone kindly show me how I am to get it into position?—ALPHA.

STAYING TELEGRAPH POSTS.—a b and c d are two telegraph posts of equal height, firmly fixed into the ground. How can m d be



proved to be a stronger way of staying than n x b? Also, what is the compressing thrust on the strut x y, and the bending moment about y?—TELEGRAPH POST.

WATER FLOWING INTO JET CONDENSER.—Will some fellow-reader kindly give me a worked-out example of the quantity of water that will flow through a 4in. pipe 30ft. long, with four bends, into a jet condenser with 18in., 24in., and 28in. of vacuum; wheel valve wide open, giving same area as pipe; also with it half open? The water supply tank is 8ft. below condenser. The condenser is working on a set of triple-expansion engines. What effect have bends and temperature on supply water?—SUGAR MILL, North Queensland.

LOCOMOTIVE CONSTRUCTION.—Will any correspondent enlighten me as to the mode adopted in locomotive work in order to fix the position of the axles (horizontally) so that each axle may have a predetermined portion of the total weight resting upon it? Say:—

Load on leading axle	0·32
„ driving „	0·48
„ trailing „	0·20
	1·00

Of course, I am aware there are certain circumstances—such as length of barrel, position of firebox, etc.—which in practice to a great extent influence this, but the point I wish clearing up is: Given the total weight, how are the positions of axles determined so that the pre-arranged weights rest on them? An answer would be of service to others as well as to—HILLSLAND.

Replies.

☞ Owing to the constant increase in our correspondence we regret that we have no alternative but to announce that we cannot reply by post to Queries even when stamped envelopes are sent.

☞ Queries and Replies must in all cases be accompanied by the names and addresses of the writers, as no notice will be taken of anonymous communications.

J.C.M.—Try Messrs. Howell and Co., Sheffield Tube Works, Sheffield.

EMIGRANT.—"Saw Mills: their Arrangement and Management," by M. Powis Bale, 10s. 6d., will probably suit you. It may be had from our office.

BOLT.—We believe examinations are held when vacancies occur, and are duly advertised in the leading technical journals and in the "Times." We do not think you will succeed in obtaining an examination paper.

BOILER MAKER'S APPRENTICE.—You are not likely to obtain much assistance through our columns. We would advise you to carefully read the articles on the "Under-type Engine," which will give you an idea of the relative sizes of engine and boiler.

F. JONES.—The moment of the weight at the end of the lever is 20 × 24 = 480, and this divided by the distance from the fulcrum to the valve centre gives $\frac{480}{2}$ = 240lb. as the pressure on the valve. As the area of the latter is ½sq. in., the pressure per square inch exerted on the water is 240×3=720lb.

FEED-WATER HEATER.—Could anyone kindly give the square feet of heating surface for a 6in. feed-water heater, or the best allowance per I.H.P. of engine? What is the usual amount in a first-class heater, say Atkinson's or Berryman's?—P. H. S.—*A.*—The area in square feet of the tubes of feed-water heaters may be calculated by the following rule:—$A=1{\cdot}25\,E^2$, in which A=area of tubes in square feet, and E=diameter of exhaust pipe of engine in inches.

COLLIERY HAULAGE PLANT.—I should be very pleased if some reader would give me some information on the following subject. In laying down a plant for endless rope haulage at a colliery the following data are given:—The engines are fixed at the pit bank, at a distance of 20yds. from the shaft. The shaft is 200yds. deep. Ropes are carried down shaft in wooden boxes. Said ropes are 1¼in. round steel. From the pit bottom the haulage extends a distance of 3000yds. Starting at the end farthest from the pit bottom, the road rises 1 in 20 for 300yds., then 1 in 14 for the next 200yds., then it is level for 100yds., then a fall towards the bottom of 1 in 30 for 200yds., then a rise of 1 in 5 for 300yds., and the remaining 1900yds. has a rise of 1 in 21. The speed of the rope is 1½ miles per hour. The weight of the corves is (empty) 4cwt., and each corf contains 8cwt. These are hung on the ropes in pairs at a uniform distance of 10yds. apart. The empty corves are hung in the same way. The driving pulley on engine to be about 6ft. diameter. The boiler pressure is 50lb. The rope runs over the corves, and in the 3000yds. each rope has 10 holding up pulleys. What I should like to know is how to calculate the H.P. required to run the haulage; also how to calculate the size of engines and gearing to develop a H.P. having sufficient margin for same; also what margin is necessary? In this arrangement the road is pretty straight. What difference would it make to the power required, supposing there is a curve in the roads containing an angle of 135°?—NOVICE.—*A.*—As this query has not yet been answered, I beg to offer a reply, which I hope will be suitable:—

The number of corves per minute = 4·4
Weight of corves and load per minute ..... = 5913·6lb.
Weight of empty corves going down per minute ..... = 1971·2lb.
Weight to lift vertically = 5913·6 − 1971·2 = 3942·4lb.

Now, starting at the end farthest from the shaft, we have the following vertical heights: First, a rise of 1 in 20 for 300yds. gives a vertical height of 45ft.; second, a rise of 1 in 14 for 200yds. gives a vertical height of 42·80 t.; third a drop of 1 in 30 for 200yds. gives a fall of 2000ft.; fourth, a rise of 1 in 5 for 300yds. gives a height of 180ft.; fifth, a rise of 1 in 21 for 1900yds. gives a height of 271·428ft. Total height to which material is lifted, after deducting the fall of 20ft. = 418·22ft. This is the total vertical height the load is to be raised. The H.P. required to raise 3942·4lb. through 418·22ft.

$$=\frac{3942{\cdot}4\times 418{\cdot}22}{33{,}000}=50\text{H.P.}$$

The length as given by "Novice"—3000yds.—would contain 300 full and empty corves going up, and 300 empty ones going down. Total weight of corves and load on the 3000yds. of road=240 tons; friction due to this weight at 32lb. per ton=7680lb. The speed of the rope is equal to 132ft. per minute, and the H.P. required to draw the 7680lb. at 132ft. per minute is

$$\frac{7680\times 132}{33{,}000}=30{\cdot}71\text{H.P.}$$

Total length of rope=3226·6 fathoms nearly, and the total weight at 13lb. per fathom (1¼in. rope)=18·25 tons. Friction due to rope at 32lb. per ton=584lb. This is drawn at a speed of 132ft. per minute, and the H.P. required for rope

$$=\frac{584\times 132}{33{,}000}=2{\cdot}3\text{H.P.}$$

The total H.P. will be 50+30·71+2·3=83H.P. If the engine efficiency is taken at 0·8, the total H.P. will be 103·75, the steam pressure given as 50lb. per square inch, or an absolute pressure of about 65lb. per square inch. Assuming it enters the cylinder at 60lb., and we cut off at half-stroke, the average pressure will be $P=p\frac{1+\text{log. of }2}{r}-p_1=\frac{60\times 1{\cdot}693}{2}$ −18=32·79lb. per sq. in. (NOTE.—P=mean pressure, p=initial pressure, r=ratio of expansion, and p_1=back pressure, all in lb. per sq. in.) Taking ⅘ths of this for the effective work gives the average pressure as 28·69lb. per sq. in. For a piston speed of 250ft. per minute a cylinder of 24½in. diameter, or if

two cylinders are used the diameter of each should be 17½in., according to the working. I should think two cylinders of 18in. diameter each would also do the work. The stroke might be 3ft. or 4ft. I have shown how I have arrived at the result, and hope it will be satisfactory.—ENGINE DRIVER.

Latest Inventions.

APPLICATIONS FOR LETTERS PATENT.

When Patents have been "communicated," the name of the communicating party is printed in italics.

Where complete specification accompanies application, an asterisk is suffixed.

11th July, 1892.

12,691 ELECTRO-MAGNETIC APPARATUS for CONTROLLING ELECTRIC LIGHT and POWER CIRCUITS. S F Walker.

12,693 APPARATUS for AUTOMATICALLY LOCKING and UNLOCKING RAILWAY CARRIAGE DOORS. J Pickles and C Arnold.

12,699 STEAM TRAPS. D B Morison.

12,700 APPARATUS for CARRYING or CONVEYING TELEGRAPH or TELEPHONE WIRES OVER HOUSES. D W Peaks.

12,701 DRY GAS METERS. F Wright.

12,716 APPARATUS for MAKING, HEATING, and ILLUMINATING GAS.* A Noteman.

12,719 PROCESS of MAKING ALUMINIUM. H J Allison. (*P A Emanuel*, United States.)

12,728 COMPOUNDS SUITABLE as PROTECTIVE COATINGS or PAINTS for IRON and STEEL.* P Lehmann.

12,729 LOCOMOTIVE ENGINES.* J Burdett.

12,731 ELECTROLYTIC EXTRACTION of ZINC. Siemens Brothers and Co. Limited. (*Messrs. Siemens and Halske*, Germany.)

12,732 PROTECTIVE PAINTS or COMPOSITIONS for SHIPS. L Pflug.

12,733 PROCESS for the PRODUCTION of METALLIC ANTIMONY. C D Abel. (*The firm of Wirth and Co.*, Germany.)

12,734 SWITCHES for RAILWAYS.* O A Sjostrom.

12,735 SUPPORTS for TELEGRAPH INSULATORS. J C and G Fuller.

12,737 ELECTRIC SWITCHES and INCANDESCENT LAMP HOLDERS. T Jenner and G B Wilkes.

12th July, 1892.

12,745 ELECTRIC SIGNALLING APPARATUS.* H J Allison. (*The Standard Electric Signal Company*, United States.)

12,755 HYDRAULIC MOTORS. A Vilanova.

12,759 ELECTRIC RAILWAYS. W P Thompson. (*A Hand H D Heatzman*, United States.)

12,762 COMBUSTION of CARBONACEOUS FUEL.* E A Erb.

12,765 SMOKE CONSUMER and FUEL ECONOMISER. L Delaney and P Kershaw.

12,766 OSCILLATING PISTON STEAM ENGINE. A Hudson.

12,768 MACHINERY for MANUFACTURING BLOCKS or BRIQUETTES of FUEL. R Middleton.

12,769 MACHINES for GRINDING or TRUING LATHE CENTRES.* H E Hawes and W D Edmonds.

12,776 REGULATING TEMPERATURES in MANUFACTURING METALS. R E B Crompton.

12,784 SMOKE CONSUMERS. J M Cottam.

12,793 TURNING TOOL. C Berle.

12,796 COMBINED STEAM and AIR WATER-LIFT. E Perrett and W C Penn.

12,797 MANUFACTURE of CARRIAGE AXLES. J Lones and others.

12,807 APPARATUS for REGULATING the ARC in ELECTRIC ARC LAMPS. A W Money and H Nash.

12,813 RAILWAY SIGNAL COMMUNICATOR and FOG ALARM. P Benns.

12,814 ROLLING METAL. A B Cochrane and H B Sheridan.

12,818 CONDUITS for ELECTRIC RAILWAYS.* J E Evans-Jackson. (*C D C Huestis*, United States.)

12,821 POWER HAMMERS.* J Parkinson and H Lindley.

12,825 MEASURING the DRAUGHT in FURNACES. G Lustig.

12,826 AUTOMATIC FIRE-EXTINGUISHERS.* R W Newton.

13th July, 1892.

12,833 SCREW BOLTS. J B Brooks.

12,839 PREVENTING RACING in MARINE ENGINES. J T Rae.

12,841 LUBRICATORS.* R Commichau.

12,853 HYDRAULIC JACKS. A Smith.

12,860 SAFETY ARRANGEMENTS for FLOATING and STATIONARY INFLAMMABLE OIL STORAGE TANKS. B H Thwaite.

12,861 APPARATUS for INCREASING the SPEED of FLOATING STEAMSHIPS. G E and J E Dehady.

12,864 MECHANISM for APPLYING BRAKE POWER to TRAINS. F H Dodson and J L Symington.

12,865 DREDGING CRANES. E Davies.

12,869 APPARATUS for HEATING by STEAM. L Johnstone and W A Greening.

12,871 CHAINS DESIGNED for TRANSMITTING POWER. H Duboulet.

12,873 FLUID SUPPORT for ORE CONCENTRATING BELTS.* C U Fisher. (*F G Corning*, United States.)

12,879 TRAM RAILS. G H Richmond and C G Norris.

12,891 CONSTRUCTION of PITCH CHAINS.* D Francis. (*T G McLelland*, South Africa.

14th July, 1892.

12,893 APPARATUS for HARDENING and TEMPERING STEEL WIRE. M Hillas and R Squire.

12,901 IMPROVED ARRANGEMENT of PACKING SPRINGS.* W Buckley.

12,915 ROTARY ENGINES, PUMPS, and BLOWERS. A F G Brown.

12,916 FLUID-PRESSURE REDUCING VALVES. W J Crighton.

12,920 TREATMENT of ZINC and in the RECOVERY of BYE-PRODUCTS. W Wright and J B Hamond.

12,924 APPARATUS for MANUFACTURING OIL GAS. The Northern Counties Hydro-Oxygen Gas Company Limited and P B W Goble.

12,926 MACHINERY for SWAGING RODS and OTHER ROUND ARTICLES. W H Dayton.

12,927 MACHINERY for SWAGING RODS and OTHER ROUND ARTICLES. W H Dayton.

12,930 FURNACES. E G Brewer. (*La Société E Herrmann and Cohen*, France.)

12,936 MOULDING for CASTING METALS. D Earnshaw and C C Cooper.

12,937 HEATING JACKETS and RECEIVERS of STEAM ENGINES. R Hoyle.

12,939 TREATING VITREOUS SUBSTANCES for MAKING METALLIC CONNECTIONS THERETO. H Doulton and J Slater.

12,944 BRAKE APPARATUS for RAILWAYS. W K Birkinshaw and T H Heard.

12,963 PREVENTING COLLISIONS on RAILWAYS. F W Golby. (*C Brumaire, E Depétro*, and *G Diss*, France.)

12,965 MEANS for TEMPERING and HARDENING METALS.* J S Durning.

12,966 ADDING MACHINES. W L Wise. (*C A Oakes* and *J H Jackson*, United States.)

12,967 PERMANENT WAY of RAILWAYS. G E Moore.

12,972 AUTOMATIC VALVE for DRAINING STEAM CYLINDERS and PIPES. F W Cannon and J A Bauer.

12,976 RAILWAY FOG SIGNALS. T H Skinner.

15th July, 1892.

12,990 DIRECT-ACTION MOTORS.* B D Healey and G Southern.

12,996 METALLIC SHEATHING for the OUTER SURFACES of the HULLS of SHIPS. J B Lee.

12,999 DISTRIBUTING ELECTRIC CURRENTS. G Kapp.

13,001 SCREW BOLTS or HEADED SCREW PINS and NUTS. J B Brooks.

13,005 MOULDS for CASTING INGOTS of STEEL. G A Clough.

13,006 TURNING RAILWAY POINTS and OPENING and LOCKING RAILWAY SWITCHES. G Brockelbank.

13,007 SUPPLYING FUEL to GAS PRODUCERS. J W Armstrong.

13,012 SAFETY APPARATUS APPLICABLE to HOISTS. J T Calow.

13,015 ELASTIC WASHERS for ADJUSTING PAPER-RULING DISCS and CIRCULAR SAWS on REVOLVING SPINDLES. W Jamieson.

13,039 ELEVATING PISTONS or PLUNGERS and CHECK VALVES for PUMPS.* A J Boult. (*Passart frères*, Belgium.)

13,016 SELF-OILING AXLE BOXES for RAILWAY VEHICLES. C A Park.

13,019 GENERATING STEAM in BOILERS. T S Lemon.

13,023 HEATING and VENTILATING RAILWAY CARRIAGES.* R Bell.

13,027 LIGHTING of RAILWAY SIGNAL and OTHER LAMPS. S T Dutton, jun.

13,028 PROPELLER SHAFTS of STEAM SHIPS. W H Ellis.

13,032 APPARATUS for SAWING STONE. C Hedges.

13,035 MEASURING the DENSITY of GASES. R Haddan. (*W Durr and A Custodis*, Germany.)

13,053 APPARATUS for HEATING RAILWAY VEHICLES. H H Lake. (*The Consolidated Car Heating Company*, United States.)

13,054 ARRANGEMENT of APPARATUS for PRODUCING MOTIVE POWER from a STEAM JET and AIR PRESSURE. F W Cannon and J L Smith.

16th July, 1892.

13,059 WRENCHES. W P and T Fox.

13,072 COUPLING and FIXING GLASS TUBES for CONTAINING ELECTRIC WIRES. D Rylands and S Slater.

13,075 SMOKE CONSUMER for FURNACES. P J McKinley.

13,077 GAS ENGINES. D Davy.

13,083 CALORIMETERS. H Junkers.

13,088 MIXING VALVE for PETROLEUM and OTHER MOTORS. J Y Johnson. (*M Hilie*, Germany.)

13,089 COUNTERS for INDICATING the NUMBER of REVOLUTIONS of SHAFTS.* H Phillips.

13,090 PORTABLE ELECTRIC LAMPS and SAFETY FUSES for SAME. K W Hedges.

13,094 APPARATUS for FLANGING and PUNCHING METAL BLANKS. C G Owen.

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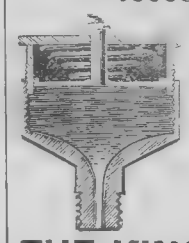
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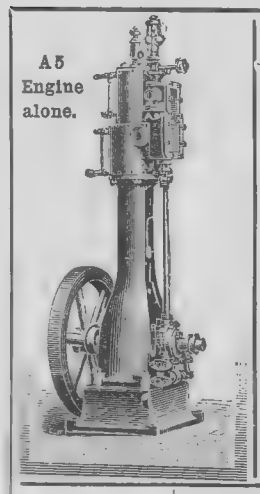
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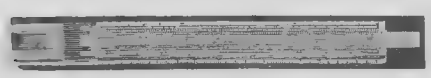
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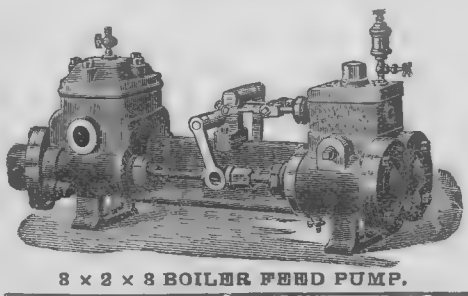
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FRIDAY, AUGUST 5TH, 1892.

Tunnel Ventilation.

THE difficulty of efficiently ventilating railway tunnels of considerable length is generally acknowledged, and most passengers on the Metropolitan Railway will, we opine, willingly admit that there is much room for improvement in this direction. An attempt to secure the effectual ventilation of the tunnel through Baltimore is now being made by the Pennsylvania Railroad, fans driven by electric motors being employed for the purpose. A ventilating stack and fan are being erected in the centre of the northern section of the tunnel, and a power-generating station is placed at one end of the tunnel. The plant will include an engine, four boilers, generator, and the necessary electrical apparatus. The currents for the operation of the fans will be conducted by wires, which can be run through the tunnel or above ground to the ventilating shafts. From this central power-house it is also intended to light the tunnels by electricity. The ventilation will be accomplished by building a slanting subway 8ft. wide by 16ft. high from the side of the tunnel, near its top, to the foot of the ventilating stack, which, on account of the heavy foundation necessary, will be located at the side of the tunnel. At the foot of the shaft a large fan, fashioned like the blades of a steamboat propeller, will be revolved on a vertical shaft, creating a strong upward draught. The vacuum formed at the middle of the tunnel will cause the smoke and gas to be drawn from the end of the tunnel to its middle and out at the top of the stack. The stacks are to be 100ft. high and 18ft. square. Adjoining each stack a small ornamental brick house will be erected for the storage of oil and materials used in operating the system. Owing to the smoke and gas being thrown off at such a great height, and also by reason of the fan through the use of electricity being practically noiseless, the disagreeable features of using boilers and engines are reduced to a minimum. By this system it is expected that the tunnel will be cleared of smoke and gas in less than two minutes after the passage of a train.

Electric Welding of Rails.

THERE seems to be little doubt that the greatest weakness to be found in tramway lines is at the joints. There it is that arise difficulties which have not yet been entirely overcome, especially in the case of steam tramways. The lengthening of the fishplates has not proved to be very beneficial, but when long fishplates, used in conjunction with soleplates, have been employed, better results have been obtained. What has aptly been termed cold rolling—namely, the continuous passage over lines of heavy steam cars, thus wearing down the rails—has greatly affected the joints. To overcome the difficulty Mr. A. Dickinson recently suggested that the rails should be welded together by electricity, but he omitted to take into consideration the necessity for joints so as to provide for contraction and expansion of the metals. The proposal was not favourably received. It is, however, now reported that the welding of rails by electricity so as to avoid the use of fishplates has been experimented with in several engineering works in the United States. The report states that two pieces of steel 25sq. in. section can be welded, and that a solid rail a few miles long could be made if necessary. Contraction and expansion are considered to be of much less importance than is generally believed, but no figures are forthcoming concerning the results of the tests, which are said to have been entirely successful. If these two points can be neglected, the life of the rails prolonged, and fishplates dispensed with, electric welding should receive an impetus; but for the moment this is mere supposition, and a line would have to be tested for a few years to obtain reliable data on the subject.

The Atlantic Record.

THE "City of Paris" has once more proved her sterling qualities as a greyhound of the Atlantic, by breaking last week no less than three records. Not only did this vessel succeed in making the fastest passage—5 days 15 hours and 58 minutes,—but her average speed and daily runs have exceeded anything previously accomplished. The nearest approach to the latest achievement of the Inman liner is the notable voyage of the "Teutonic" last year, when on three of the daily runs more than 500 miles was covered—viz., 505, 510, and 517. The "City of Paris" has, however, improved upon this, having run distances of 501, 504, 519, and 520 miles, the highest of these figures giving a rate of rather more than 21 knots, or 24 statute miles per hour. Her average speed for the whole voyage was 20·48 knots, as compared with 20·35 done by the "Teutonic." Having thus outpaced the White Star liner in so many ways, it only remains that the "City of Paris" should add to her laurels by a speedy eastward voyage. At present the "Teutonic" holds the premier place there, just as she formerly did in the westward run, her passage in October, 1891, of 5 days 21 hours and 3 minutes, being rather better than that of the "City of Paris" in December, 1889, of 5 days 22 hours and 50 minutes. It will be interesting to watch the future developments of this branch of the Atlantic contest, especially as the "Majestic" and "Teutonic" have been sent fresh from the hands of the engineers after a thorough overhaul, to compete with the two vessels which now sail under the stars and stripes. Next year we may expect the contest to become still more interesting, as the two large Cunarders now under construction at Fairfield will take part in the race. Much is expected of these new vessels, and certainly, with their great length, enormous displacement, and engines estimated to give a speed of 22 knots per hour, the "Campania" and "Lucania" promise to be the largest, and swiftest, and probably the most luxurious of ocean steamers afloat.

Electric Lighting of the Belgian Royal Carriage.

A NEW railway saloon carriage for the Belgian Royalty has just been completed by the Engineering Works of the Belgian State at Malines. This vehicle is lighted by electricity, the current being furnished by a battery of Julien accumulators placed longitudinally. All the lamps are arranged to have the same lighting powers; and the conductors, strange to say, are carried outside the carriage. The charge of the accumulators ensures a light for ten hours, and the recharging of the battery is effected either at the Northern Railway Station or at any other station where an electric-lighting plant exists. The carriage, which is fitted with both the Westinghouse and vacuum brakes, is the first to be electrically lighted on the Belgian railways.

The Mines of Huelva.

DURING the last twenty-five years the mining industry of the province of Huelva has undergone an immense development. The first great impulse was given by the foundation, between 1866 and 1875, of large foreign companies. The mines began to be thoroughly opened out, railways were constructed to the port of Huelva, and magnificent shipping piers were built in the river. Other companies then followed, and a period of great activity set in, completely altering the aspect of the province and of the port. The copper pyrites, or cupreous sulphur ore, composed of about 48 per cent. sulphur, 44 per cent. iron, and 3 per cent. copper, is the principal ore mined in the district, and contributes very considerably to the copper production of the world. By far the greater part is sent to Great Britain, although large quantities are sent to Holland and Germany; France and the United States are also consumers, and a small quantity goes to Denmark. British vessels convey nearly all the copper pyrites, but a good many cargoes have been shipped to Germany in German steamers. The pyrites sent to the United States is of the poorer class, containing about 1¼ per cent. of copper only on the average, and is shipped principally to Philadelphia and New York. The ore is also partly treated at Huelva by smelting, which produces the regulus, containing about 30 to 40 per cent. of copper, and by precipitation on to pig iron in large tanks, giving cascard or precipitate with 60 to 95 per cent. of copper, according to treatment. The iron pyrites is what is called pure—that is to say, it contains 44 per cent. of iron and 52 per cent. of sulphur, but no copper, and it is extracted from one mine only. Besides the considerable quantities shipped to Great Britain, there is a large consumption in France, Germany, and the United States; it is, as a rule, friable, and not hard and compact like copper pyrites. Manganese has been exported in larger quantities recently, but the low price still keeps a great many mines closed. The metal is very generally distributed over the mining district of the province, and is of a good quality. Neither quicksilver nor lead is a product of Huelva, the former coming from the famous mines at Almaden and the latter from the Linares district.

Beams and Girders.

IT is often necessary to decide quickly what sort of girder or beam shall be used over a bay window or shop front, or across any wide span. Too many architects neglect to calculate the required strength, and so fail in some cases to economise materials. To ascertain the required strength we should first estimate the amount of walling, whether brick or stone, which the beam will have to carry. Remembering that when the load is evenly distributed the beam will carry twice as much as when it is concentrated in the middle, we shall guard against taking the amount of walling, deducting the window openings, and then regarding the net amount of walling as an evenly distributed load. When there is a central pier between the windows, it is obvious that a large proportion of the weight comes upon the centre of the beam, and ought to be provided for. A safe and sufficiently accurate plan is to regard such a pier as being concentrated upon the centre of the beam, and to take all the rest of the walling as an evenly distributed load. A rough estimate of the weight will do, and whether the walling is of brick or stone it may be calculated at 1cwt. per cubic foot.

Next we have to consider what the beam will carry besides the walling which rests upon it. It will have to carry its share of any floor whose joists take their bearing upon the beam itself or upon the wall which it carries. Half the entire load upon any such floor will be carried as a distributed load upon the beam. For the weights per square foot which floors should be calculated to sustain, including the weight, in each case, of the floor itself, Hurst's "Handbook" gives the following: Ordinary dwelling-house floors, 1½cwt.; public buildings, etc., 1½cwt.; and warehouses, factories, etc., 2½cwt. to 4cwt. Next we (the "Contract Journal") have to consider what roofing abuts upon the wall carried by the beam. We shall probably have a sloping surface of roof, one-half of which is supported by a purlin or a ridge, while the other half rests upon the wall. The weight of this latter portion may be calculated at 40lb. per square foot, to include the weight of timbers and roofing, with all necessary allowance for occasional stress caused by weight of snow and high winds.

Having made these preliminary calculations, we have to decide what sort of beam will serve our turn. Suppose we require a beam to carry a 3½in. wall over a 10ft. opening, the total distributed upon the beam being 6 tons. Reckoning the safe load upon a beam at one-fifth of its breaking weight, we shall find, by the usual calculation for fir, that three pieces 10in. by 4in. bolted together will exactly do the work. Giving each end of the beam a bearing of 1ft. 3in., and allowing for ⅞in. wrought-iron bolts, 14in. long, and not less than 18in. apart, we shall find that we have 10½ cubic feet of timber, and ten bolts weighing, with their heads and nuts, 23lb. If the timber cost 2s. 3d. per foot cube, including delivery and fixing, and the bolts 1d. per pound, our beam would cost us 25s. 6½d. The same weight could be carried by two rolled iron I joists, each 7in. by 2½in., weighing 14lb. per foot run, placed side by side, 6in. from centre to centre. If these could be supplied and fixed at 8s. 6d. per cwt., they would cost, if the same length as the beam, 26s. 6d.

If we suppose the distributed load to be twelve instead of six tons, the same fir beam, in three sections bolted together as described, will do, with the addition of two ½in. wrought-iron flitches in between the sections of the beam. These flitches should be 1in. less deep than the beam, so that the timber may shrink a little without throwing the whole weight upon the iron, which would have a disastrous effect upon the brickwork. There would therefore be 18¾ft. super. of ½in. iron plate, weighing 20¼lb. per foot, which would amount to 3cwt. 44lb., and, if priced at 8s. per cwt., would cost about 27s. Then we have to allow for drilling 20 bolt holes, at, say, 4d. each—amounting to 6s. 8d.; so that the timber, flitches, and bolts complete would cost £2 19s. 2½d.—say £3. The same weight could be carried by two 6in. by 5in. rolled joists, weighing 29lb. per foot run each, and costing £2 15s. 4d., at 8s. 6d. per cwt.

Engineering Pattern Making.

By a Foreman.

XXI.

In making the corebox for the grooves of large rope pulleys, the ends of the box are cut to the section of the outside of the pulley as shown in Fig. 132, and a strickle of the same shape working on the side of the box forms the core. This method is adopted as a means of saving timber and time, as a great amount of both would be expended in making a complete corebox such as used for a small pulley.

In some cases it is required to cast wrought-iron arms into the boss and rim of rope and other pulleys, and when this is to be done the pattern is made in every respect similar to those described, only that the arms are made exactly the shape and size of the wrought-iron ones which it is intended to cast in.

It will be seen that the interposition of the wrought-iron arms would prevent the flow of metal through the space representing the arms in an ordinary mould, hence the necessity for casting them by first running the boss and then the rim, or *vice versâ*. Similarly wrought iron arms may be cast into a centre or boss by making a pattern to receive the required form of arm as shown at Fig. 134, where the rim may be of another substance and bolted to the arms. When wrought iron is brought in contact with molten iron for the purpose of casting the one upon the other, that part of the wrought iron to be fastened in the casting should be tinned over or daubed with a mixture of red lead and turpentine to prevent blowing. Further, when boss and rim enclose each end of a wrought piece, they should be run as quickly as possible to avoid the "blowing" consequent upon the generation of steam or vapour in the mould by the contact of the hot metal with the damp sand.

In the preceding example, where the pulley is formed entirely by means of cores, straight arms *only* have been considered, but as C and S arms are frequently specified, a somewhat different arrangement is required so that the latter shape of arm may be taken out of the core, and this may be done in either of the following ways :—

Fig. 135 shows a corebox containing an S arm in place of the straight one previously given, and it will at once be seen that it is not possible to treat it in the same manner—viz., to draw the arm out of the core when rammed up. This apparent difficulty is got over by making a joint in the core along the centre of the arm. This joint is then freely sprinkled with parting sand, and a grid or core iron (Fig. 136) with taper "prods" is used to carry the top half of the core, which when rammed up is lifted out of the box, the S arm taken out and the parting sand brushed off, and either clay wash or a very thin coating of loam used to joint the half cores together, which are then ready for drying. By a somewhat similar arrangement the core is jointed after each half has been made by means of right and left-handed boxes, each of which contains the half arm, rim, and boss cut through the centre horizontally, as shown at Fig. 137. This method dispenses with the "prods" on the grid or core iron, as it will be seen that projections are not allowable when this class of box is used ; hence it is not so reliable as the entire box (Fig. 135), and consequently the latter has found more favour, as it ensures the more uniform casting and reduces the cost in the pattern shop. In any case it is necessary to make grids or core irons to support the mass of sand, and in these it is usual to cast a couple of iron nuts into which are inserted eyebolts for lifting the core into position. These core irons are generally made on a level bed of sand, the corebox being turned with the open side down, thus giving a slight impression and showing the actual outline of the inside. A "peg" rammer (Fig. 138) is then used to form the core iron mould, and the nuts as above mentioned are laid between the bars forming the core iron (Fig. 139), and kept down by means of a piece of bar iron or anything sufficiently heavy to prevent it from being disturbed by the flow of the metal, and at the end of the open sand mould where the core iron is run a "git" core is placed, through the opening of which the metal is poured. This is used for the purpose of saving the edges of the soft sand from being washed by the weight of the metal.

The C arm (Fig. 140) when used in a corebox may be taken out in the same manner as a straight one, though its form requires a little more trouble, and some patience is sometimes necessary to draw it through the core after the latter is released from the box.

(To be continued.)

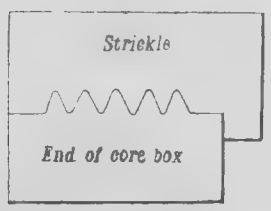


Fig.133

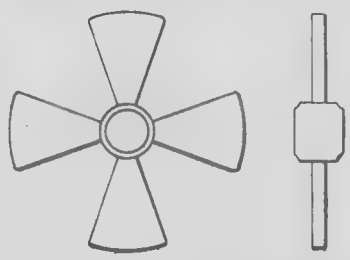


Fig.134

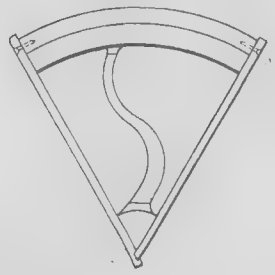


Fig.135

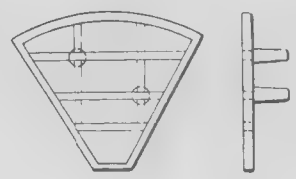


Fig.136

Engineering Pattern Making.

On the Applications of Electricity in the Royal Dockyards and Navy.*

This is an age of electricity ; and the fact is well exemplified on board a modern battle-ship of the Royal Navy. Some of the applications of electricity in the naval service do not come within the scope of ordinary mercantile practice ; and in the case of those which do, the naval experience is of a special kind, and may be of some value to those outside the service. A statement therefore of naval methods and practice up to date may not be without interest and instruction to the members of this institution. At the present time visitors to Portsmouth dockyard will probably be surprised, if not disappointed, at the somewhat primitive character of the workshops devoted to the electrical testing and construction. This branch of work was commenced in a very small way about seventeen years ago, and found a temporary home in a small shed which had been previously used for a different purpose. As the work from time to time has grown, this shed has been enlarged as far as available space would permit. Designs have been prepared for a more substantial and suitable building in the hope that in time the Admiralty will be able to devote sufficient money to providing a proper habitation for this important branch of dockyard work.

The larger proportion of the plant required for electric installations in the navy is not made in the dockyard. Formerly all dynamos and their engines were obtained entirely by contract ; but recently five sets of these have been designed and constructed in the dockyard. After patterns of the smaller fittings have been fixed, the supply of these also in bulk has generally been obtained by contract. There is, however, a great deal of work left to be done in the dockyard—in testing and installing these fittings in the ships, in carrying out repairs, and in devising and preparing patterns of new fittings to meet the constantly growing requirements of the navy. There is also some work which for obvious reasons is confined to the Royal workshops.

The applications of electricity in the navy may be dealt with under the following heads :—(1) search lights ; (2) internal lighting of ships, including temporary installations in ships building and repairing ; (3) torpedo and gun circuits ; (4) electric communication ; (5) other applications.

1.—Search Lights.

The introduction of the search light, without which no modern warship or torpedo boat would be considered complete, dates from 1876 ; and the first vessel in the navy fitted with a search-light apparatus was the "Minotaur." Some experiments had been carried out in the previous year by Messrs. Wilde and Co., of Manchester, on board the gunboat "Comet"; and these proved so far satisfactory that a complete plant was ordered and fitted on board the "Minotaur." The dynamo employed was one of the alternating current type with 32 magnets, and was driven at about 400 revolutions by a belt from an auxiliary pumping engine. The projector was of a primitive type, and pedestals were fixed in three different places, from one of which the same projector could be used. It was fitted with a parabolic reflector and with dioptric and diverging lenses. A diaphragm was also provided for enabling flashing signals to be made. The lamp employed was Wilde's, and was a vertical one. The carbon rods were square in section, and their holders were made to slide on two pillars, and were moved up and down by a central pillar with a screw-thread cut in it. The lamp was hand regulated, and one lead was put to earth. The "Téméraire" in the same year was next fitted in a similar manner, with the exception that a Mangin projector was introduced, fitted with Wilde's lamp, lens, etc. In the next year, 1877, the "Dreadnought," "Neptune," and several other vessels were fitted with the same class of apparatus.

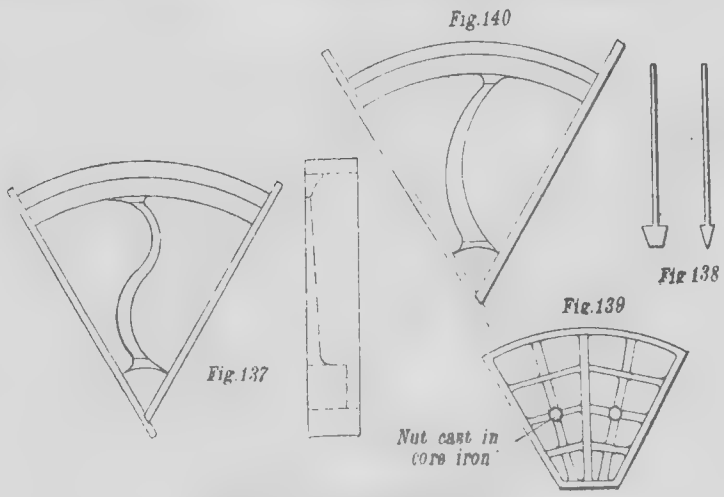
In 1878 direct driving was first introduced. In this year Messrs. Wilde and Co. coupled their machines to engines made by Brotherhood and by Chadwick, of Manchester. The dynamo was also improved, so as to be able to maintain two arc search lights at one time. In the same year also the "Triumph" was fitted by Messrs. Siemens Brothers with a search-light installation. The dynamos were four in number, of horizontal type, arranged in two pairs, and each connected in parallel to one circuit. A switchboard was fitted for enabling any two of these dynamos to be coupled up together on any circuit. It consisted of a wood base with two sets of bars at right angles to each other, one set on the top of the base, and the other underneath. One set of bars was connected to the dynamos, and the others to the circuits. At their intersections these bars could be connected as required by means of suitable plugs. The projector used was a Siemens holophote, which was heavy and clumsy, being made largely of cast iron. It was fitted with diverging and dioptric lenses; of these the latter was composed of concentric glass rings of triangular section, held in a metal frame. It had also a flashing arrangement. The lamp used was one of the Siemens self-regulating type, and had a small mirror fixed to it. It was complicated, and frequently got out of order. The carbons were apt to stick together, and the lamp was sensitive to any slight variation in speed of the dynamos. This lamp did not come into general use.

Subsequently the Gramme dynamo was introduced for search lighting by Messrs. Sautter Lemonnier, of Paris ; and in 1881 the "Inflexible" was fitted with this dynamo. In this installation the Mangin projector was used, with a Mangin mirror instead of the dioptric lens. The lamp was hand regulated and inclined. The Gramme dynamo has since been superseded by others of later make ; but the Mangin mirror and the inclined hand-lamp survived, and became the standard service fittings.

Naval Service Projector.—Out of these earlier attempts the modern naval service projector has gradually been evolved, which has now become familiar to most persons. It consists of a cylindrical lantern made of very thin steel, with a silvered glass parabolic mirror at the back end, in the focus of which an arc light is produced between two carbon sticks, held in what is known as an inclined hand-lamp, the carbons standing at an angle of about 70° to the axis of the mirror. The feeding of the carbons is not automatic, but is accomplished by hand ; and the lantern is so suspended that it has motion on its pedestal through the whole circle in azimuth and through about 60° in altitude. During its motion the electrical connections are kept up by suitable rubbing contacts. A switch is fitted in the pedestal for switching the current off and on. The circuit wires, main and return, are brought from the main switchboard to the switch on the pedestal, thence to the rubbing contacts, and finally pass close together up one of the hollow arms of the lantern support, and through the trunnion-bearing to two springs at the bottom of the lamp box. The lamp when put in makes contact with these springs, and completes the circuit through the carbons. Two sizes of these projectors are used in the naval service, a larger with a 24in. mirror for ships, and a smaller with a 20in. mirror for torpedo boats. The parabolic mirror in these projectors converges the rays into a powerful and penetrating cylindrical beam of light. At the front end of the lantern diverging lenses can be attached, for spreading the beam over a larger surface when desired ; or a flashing screen can be affixed for signalling purposes.

The two most important parts of these projectors for the production of a good and steady beam are of course the reflecting mirror and the carbons. For the supply of these articles the naval service was until recently dependent entirely upon French manufacturing firms. The Admiralty, fully alive to the dilemma in which this country might under certain circumstances be placed, have sought to induce English manufacturers to enter into competition with the French firms for the supply of these articles ; and everything of this kind which has been offered with the slightest promise of success has been fully and carefully tested at Portsmouth. The English manufacturers have no doubt had no easy task to accomplish, for, disregarding cost, the French mirrors and carbons left nothing to be desired, and are still the standards to which all others are referred.

(To be continued.)



Engineering Pattern Making.

* Paper by Mr. Henry E. Deadman, Chief Constructor, Portsmouth Dockyard, at the Summer Meeting of the Institution of Mechanical Engineers.

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Hydraulic Machinery.—VIII.

FIG. 20 shows a portable pedestal crane. The jib, pillar, strut, and pedestal are of wrought iron. The lifting cylinder is placed in the pillar, and the turning cylinders are placed in the pedestal at the foot of the cylinder, one side of the pedestal being carried out to give the requisite stroke, and also to form a casing to enclose the valves and to carry the valve house. The crane is carried on strong wheels, and has screw resting blocks to enable the weight to be taken off the wheels when the crane is at work. Hydrant boxes, with pressure and

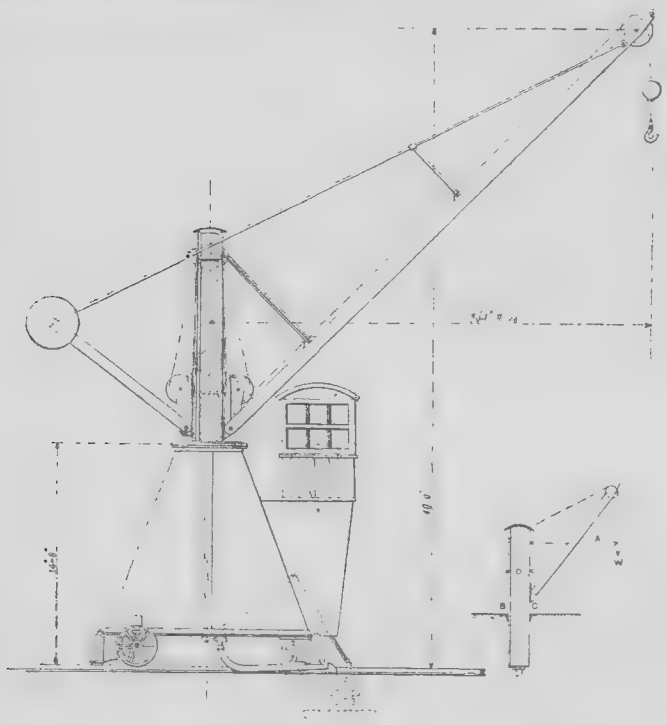

FIG. 20.

FIG. 23.

return water valves, are arranged at intervals of about 40ft. along the quay. The connection to these boxes is made by telescopic or walking pipes for the pressure, and by indiarubber hose for the return water, the range given to the pipes being about 20ft., to enable the crane to move that distance either to the right or left of the hydrant without uncoupling. A detail of the joint for the walking pipes is shown in Fig. 21, and in Fig. 22 a detail of the universal joint at the foot of the pillar for conveying the pressure water to the lifting cylinder.

This crane is also frequently made with an arch underneath, either for the passage of a man or railway trucks and locomotive. The same type is also much used as a fixed crane, the wheels being dispensed with and the crane securely bolted to foundations. The jib, instead of being fixed, may be made to luff in and out, an extra cylinder being provided for the purpose fixed on the back of the pillar. It is also often desirable to have two powers, 10cwt. and 30cwt., to save water when lifting the lighter load. This is accomplished by means of telescopic rams. The outer ram is made large enough to lift the heavy load, and acts as the cylinder for the smaller ram, being open at the bottom and in communication with the cylinder proper. To lift the heavy load both rams work out together; to lift the light load the larger ram is locked by a suitable arrangement of levers, and the small ram travels out alone. Another method is to use a ram and piston, as in the differential pump already described. If it is required to lift the heavy load the pressure is put on to the piston area, and the annulus is open to exhaust. If the light load is to be lifted, the pressure is admitted on both sides of the piston, the effective area being equal to the area of the ram. The objection to this system is the same as to the pump—viz., leakage past the piston. The three types of cranes given have all top and middle bearings.

Another useful type for foundry, fitting and turning shops, and for serving hydraulic riveters, is the pillar crane, with top and bottom bearings. The principle is, however, the same in all the cranes, the design being varied to suit the purpose for which it is required.

To determine the area of the lifting ram, let

L = load lifted in lb. + counterweight and proportion of overhanging chain.
M = the multiplying power.
E = effective pressure per square inch on the ram.
A = area of lifting ram in square inches.
W = weight of parts in lb.

$$\text{Then } \frac{LM}{E} + \frac{W}{E^1} = A.$$

TABLE OF EFFECTIVE PRESSURES FOR VARYING MULTIPLYING POWERS.

Multiplying Powers.	Accumulator Pressure × Coefficient.	Effective Pressure for 700 Accumulator Pressure.
Direct Acting	700 × 0·86	602
2 to 1	,, × 0·8	560
4 to 1	,, × 0·76	532
6 to 1	,, × 0·72	504
8 to 1	,, × 0·67	469
10 to 1	,, × 0·63	441
12 to 1	,, × 0·59	413

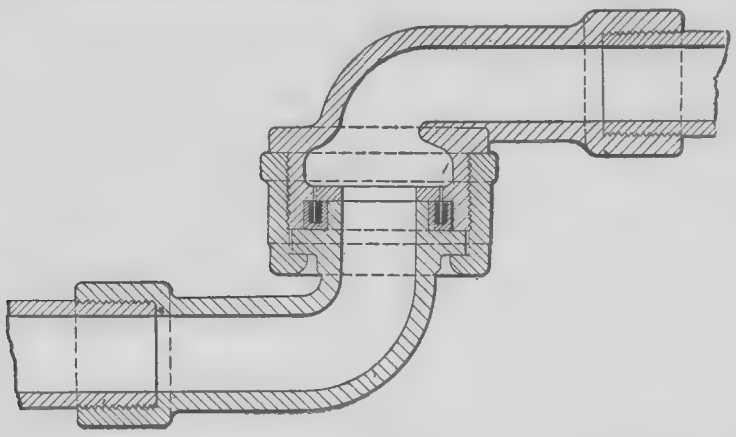

FIG. 21.

NOTE.—E^1, effective pressure for weight of parts, may be taken as 602.

To determine the area of the turning rams, let

L = the load in tons.
R = radius in feet.
C = centres of bearings in feet.
D = radius of turning drum in feet.
P = accumulator pressure in lb. per square inch.
K = constant.
M = multiplying power.
A area of turning ram in square inches

$$\text{Then } A = \frac{LR^2KM}{CDP}$$

The values of K are as under:—

70 for cranes up to 1 ton.
65 ,, ,, from 1 to 2½ tons.
60 ,, ,, ,, 2½ ,, 4 ,,
55 ,, ,, ,, 4 ,, 7 ,,
50 ,, ,, ,, 7 ,, 10 ,,

The area of the luffing cylinder is calculated in the same way as the lifting cylinder, the load being taken from the stress diagram.

When the lifting cylinder is placed horizontally, and a returning ram has to be used to return it, it is usual to calculate the pressure on the returning ram as equal to half the weight of the moving parts; and as it is usually a constant-pressure ram, its area must be added to the area of the lifting cylinders.

The area of the racking cylinders, when used, is calculated in the same way as the lifting cylinder, the pressure being taken at 100lb. per ton of weight moved; or if the jib is very stiff, so that the way is practically level, it may be calculated by the following rule:—

Let F = the pull on the chain in lb.
μ = coefficient of friction = $0{\cdot}15\frac{d}{D}$.
D = diameter of wheel in inches.
d = ,, axle in inches.
W = weight moved in lb.
Then $F = \mu W$.

Strength of Pillar.—The stress on side B, Fig. 23, is found by the principle of the lever, the fulcrum being taken at C,

Thus W × A = tension on B × D.

The compression on the side C is equal to the tension on B × the weight W. As the rivet holes are deducted on the tension side, and not on the compression side, the two sections are generally made equal. The stress on the material should not exceed 4 to 4½ tons for wrought iron, and 6 to 7 tons for mild steel. When a counterweight strut is used and the crane is balanced, as in the portable type, the balance weight puts the side C in tension and B in compression. This should be deducted from the stress found as above and the section correspondingly reduced. The depth D should not be less than from ½ to ⅓ of the radius.

The compression on the jib and the tie rods may be found by the triangle of forces in the ordinary way, the tension of the chain being resolved first and the other stresses taken from the resultant. The stress on the material may be about the same as in the pillar, but care must be taken that the jib is sufficiently rigid to resist flexure. Guide sheaves should be placed about every 12ft. centres to prevent the chain sagging and wearing the plates or bracings.

Sheave Pins.—The surface on the sheave pins should be about 1sq. in. for every 1000lb. pressure. In large cranes this is often exceeded, the pressure rising even to 1500lb. per sq. in. so as to reduce the diameter of the pins—for it must be

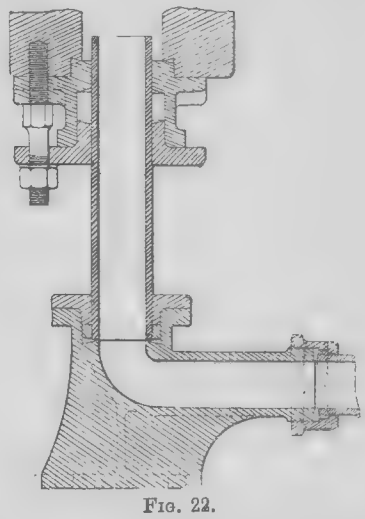

FIG. 22.

remembered that although the friction is the same with a large as with a small pin, yet the effect of the friction in the large pin is considerably increased, owing to its increased leverage.

The thickness of hydraulic cylinders may be calculated by the following rule for pressures up to 1200lb. on the sq. in.:—

Let D = diameter of cylinder in inches.
P = pressure in lb. per sq. in.
T = thickness in inches.

$$\text{Then } T = \frac{D \times P}{2 \times 3200} + 0{\cdot}38.$$

A good proportion for the flanges is 1¼ times the thickness. Bolts should not be stressed above 3 tons per sq. in. on the net section. The guide bars should be flat bars for horizontal cylinders, and square or round bars for vertical cylinders, and should be arranged with dead stops to take the full pressure of the ram. The stuffing box should hold at least six turns of packing, and when vertical should have a lip cast round to catch any drippings. An air cock should

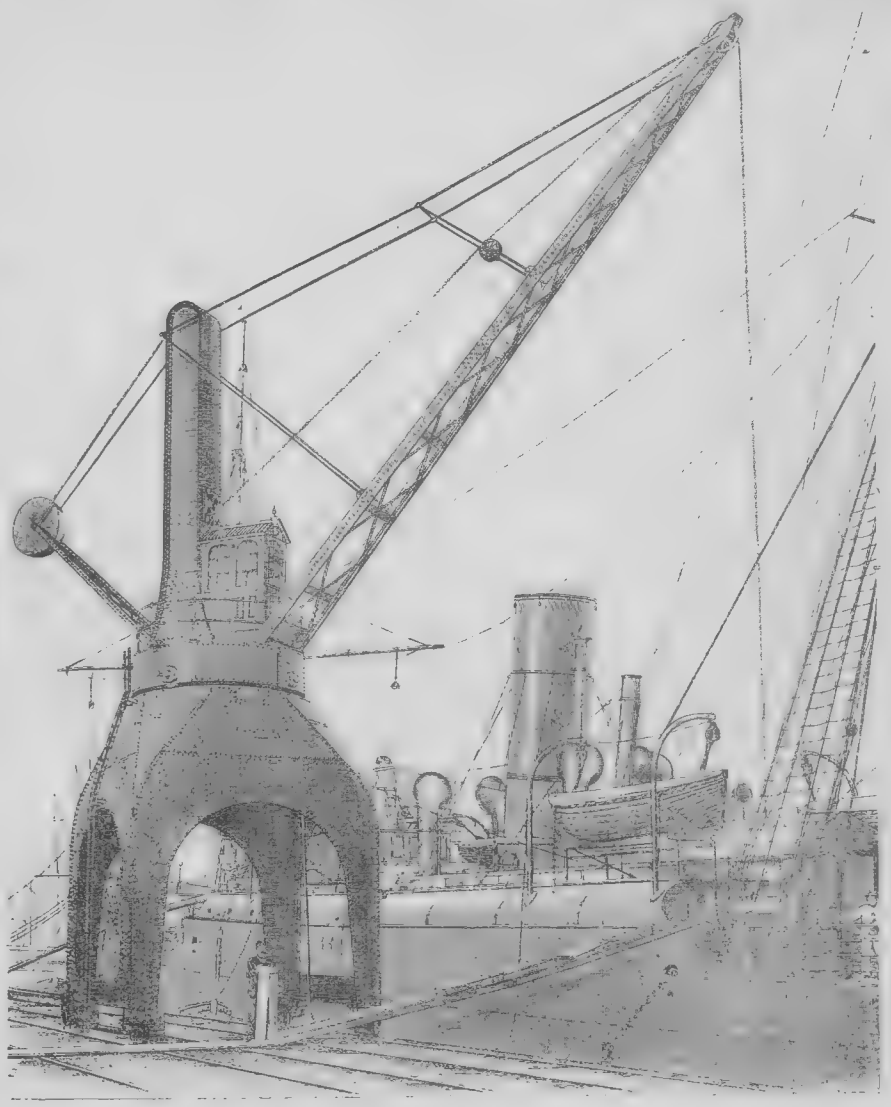

FIG. 24.

be arranged on the highest point and a drain cock on the lowest point of the cylinders.

The pressure inlet must be made to suit the size of the valve, which can be calculated from the rule already given. The diameter of chain sheaves, taking a quarter or half turn of the chain, should not be less than 20 times the diameter of the chain. Cupped turning drums are found troublesome owing to the stretching of the chain, and two methods have been adopted to dispense with them. One method is to have a double-grooved drum with a fast end for each cylinder, and with a link opening out to give the extra ½rd revolution beyond the complete circle. The second method is to use a plain drum and turn by means of the friction obtained by a double coil of the chain round it. Where only a small angle is to be turned through, as 90° to 100°, it can be obtained by a fast end in a single-grooved sheave.

Many special forms of hydraulic cranes have been designed which would occupy more space than can be allotted to these articles to describe; but for the benefit of those interested, before leaving this part of the subject I would desire to refer them to an article published in this journal on 5th October, 1883, on hydraulic cranes as used in Bessemer steel works, and also to give one other illustration of a hydraulic crane presenting special features of interest. Fig. 24 is a portable hydraulic crane with an arch underneath to allow of the passage of trucks and locomotive, the special features being the roller path on the top of the pedestal and the valve-house revolving with the crane so as to give the man in charge a full view of the load he is lifting. This crane was introduced and has been largely made by Messrs. Tannett and Walker, of Leeds.

Special hydraulic cranes are also in use for the rapid shipment of coal, a loaded wagon being lifted bodily over the ship and the coal dropped or tipped into the hold. These, however, can be best traced by referring to the patent office records, as the special features are in nearly every case protected.

(*To be continued.*)

Shipbuilding Notes.

Messrs. William Denny and Brothers, Dumbarton, launched from their yard, on the 25th ult., a steel screw steamer. The dimensions are:—360ft. by 45ft. by 30ft. 1in. She will be propelled by a set of triple-expansion engines made by Messrs. Denny and Co., Dumbarton.

Messrs. Russell and Co. launched from Kingston Yard, Port-Glasgow, on the 25th ult., a large four-masted steel barque. The vessel registers 3300 tons, and is capable of carrying 5200 tons deadweight. The dimensions are:—Length, 330ft.; breadth, 47ft.; depth, 27ft. 1in.

There was launched from the shipbuilding yard of Messrs. Scott and Co., Bowling, on the 29th ult., a screw steamer. The dimensions are:—142ft. 6in. by 25ft. by 12ft. The engines, which are of 60N.H.P., are compound surface condensing, and were constructed by Messrs. Ross and Duncan, Govan.

Messrs. Caird and Co., of Greenock, launched from their yard on the 29th ult. a new steamer of 7000 tons for the P. and O. Steam Navigation Company, named the "Australia." This vessel is 470ft. long by 50ft. in breadth, and her engines indicate 10,000H.P., which will be capable of driving her at sea at a speed of 19 knots.

On the 26th ult., Sir W. G. Armstrong, Mitchell and Co., launched from Elswick Shipyard, Newcastle-upon-Tyne, for the Argentine Navy, a first-class cruiser and a torpedo catcher. The cruiser is 350ft. in length, has a displacement of 3560 tons, 14,500H.P., and a speed of 22½ knots. Both vessels are armed with heavy quick-firing guns and torpedo tubes.

A new steamer, built to the order of the North of Scotland and Orkney and Shetland Steam Navigation Company, was launched on the 23rd ult. from the shipbuilding yard of Messrs. Hall, Russell and Co., Aberdeen. She is 165ft. in length, 25ft. 6in. in breadth, 12ft. 6in. in depth, and is registered to carry about 420 tons gross. She will be fitted with triple-expansion engines of 110H.P. nominal, and steam will be supplied from a boiler at 160lb. working pressure.

Messrs. Allsup and Sons, Preston, shipbuilders and engineers, launched on the 26th ult. from their yard a pontoon, or ferry bridge, for service between Portsmouth and Gosport. The length of the hull is 110ft., breadth 62ft., and depth 6ft. She is built entirely of steel and fitted with a pair of compound surface condensing engines, with 20in. and 38in. cylinders, with a stroke of 30in., which will drive two large cast-iron chain wheels over which passes a chain attached at one side of Portsmouth harbour to the town quay, and at the other to the Gosport landing stage. The total weight of the vessel is about 400 tons.

Experiments on the Overheating of Steam Boilers.

(*Concluded from page* 41.)

THE method adopted by the author to measure approximately the temperatures of the surface of the plate exposed to the fire is one of the most interesting features and chief points of novelty in his paper. A certain number of metallic alloys were prepared, fusible at known temperatures. Circular recesses were drilled in the boiler plate, over the area covered by the flame, and filled in or plugged with these alloys, carefully disposed in such a way that it might be safely assumed that the transverse section of each plug was of the same temperature as the iron surrounding it. After each experiment the bottom of the plate was examined. In a certain number of the plugged holes, the alloys, being fused at a lower temperature, would be found melted; in the others, filled with alloys melting at a higher temperature, they would be intact. The temperature of the surface of the metal must, therefore, during the experiment, have been between that of two of the alloys, higher than that at which the least easily fusible plug was melted, and lower than that of the plug remaining intact at the next higher temperature.

Twelve of these plugs of alloys, carefully numbered, were arranged according to the temperatures at which they melted in a circle of 2⅜in. diameter, round the centre of the bottom of the plate. A second series of twelve plugs was disposed outside these, round the same centre in a circle of 4¾in. diameter, the diameter of the boiler plate enclosed within the casing of fireclay being 6⅜in. The recesses filled in by the alloys were ⅛in. diameter and ¼in. deep, and the thickness of the boiler plate ⅜in. Each of the twelve plugs of alloys forming the outer or the inner circle melted at a different temperature, but one plug in each circle contained the same alloy, and therefore melted at the same temperature as the similar plug in the other circle. The corresponding plugs were placed at opposite sides of the circles, in order that any inequality in the heat of the flame at different points in the plate might be detected, by the melting of the alloy in the one plug, and the partial fusion of the same alloy in the plug of the other circle. The temperatures at which the alloys melted ranged from 230° F., to lead at 635° F., and zinc at 482° F. In one experiment, for instance, plug No. 7, in the inner circle, containing an alloy melting at 369° F., was found to be slightly fused; and plug No. 8, the alloy in which melted at 428°, was intact; the temperature of the plate during the experiment was therefore between 369° and 428°, but nearest to 369°.

By this method the author was able to determine, first, the approximate temperature of the plate when strongly heated from below, and secondly, the quantity of water evaporated at that temperature. His first experiments were made with distilled water in immediate contact with the plate. The results are plotted on a diagram, the abscissæ of which represent the quantity of water at 32° F. evaporated per hour per square foot of heating surface, and the ordinates the temperatures of the plates. Two lines are traced on the diagram, showing the variations of temperatures of the inner and outer circles of plugs, as compared with the amount of water evaporated. In an experiment made on the 23rd August, 1887, the temperature of the plate, determined from the plugs of alloy, fused and not fused, was between 338° and 369°, and 29lb. of water were evaporated per hour per square foot of heating surface.

From these experiments the author drew the following conclusions. The temperature of the surface of the plate was never uniform throughout. In the inner circle of plugs—that is, the part subject to the direct action of the flame—it was hotter than that within the outer circle, the difference being about 29°. The temperature of the surface exposed to the fire rises progressively with the increase in the quantity of heat passing through it. The point of greatest importance, however, is not the actual temperature of the metal, but the excess of this temperature above that of the water in the boiler, which latter is a constant—namely, 212° F. The author takes as a basis the difference between the temperature of the plate and that of the water, such temperature difference resulting in the number of lb. of water evaporated per square foot of heating surface. With an evaporation of 20lb., this difference was 135°; but the greater the evaporation the greater the difference between the temperature of the plate and of the water. With 40lb. evaporated it was 180°.

The author is of opinion that if the temperature of the water rises in any boiler, the difference does not increase in proportion. Thus, if in a boiler-plate ⅜in. thick the water be at a temperature of 356°, with a mean pressure of 8½ atmospheres, and 40lb. per hour per square foot be evaporated, the corresponding difference ought to be 180°, but the iron will never attain a temperature of 536°. It is well known that if a paper saucepan filled with water be held over a flame, the water will boil, but the paper will not burn; but if a sheet of paper be placed between the flame and the saucepan the sheet will burn directly, while the saucepan remains intact. However great the evaporation, therefore, the author thinks there is no danger of overheating, provided the metal be sound and in direct contact with the water.

But if the free transmission of heat be hindered in any way, either in the metal itself, or in passing from it to the water, different conditions are established, the effects of which were studied in another series of experiments. Two were made with water artificially thickened, and containing successively 0·2 per cent. and 0·5 per cent. of its weight in starch. These showed that the difference between the temperature of the surface and the quantity of water evaporated was slightly greater than when the experimental boiler contained pure distilled water, but the presence of starch in the water did not apparently tend to overheating.

In the next experiments the incrustations often found in the bottoms of boilers were imitated by covering the interior surface with a layer of plaster $\frac{1}{16}$in. thick. To prevent the plaster cracking, the fire during the experiment was small, and the evaporation never exceeded 37½lb. per hour per square foot of heating surface. The difference between the temperature of the plate and the water was found to be about 54° higher than when distilled water was in direct contact with the metal. The layer of plaster was then increased to a thickness of $\frac{1}{16}$in., when to evaporate 30lb. of water the external temperature of the iron plate rose above 482°, and to evaporate 40lb. it exceeded 752°. The differences between these temperatures and those obtained when the water and the metal were in immediate contact were respectively 63° and 378°.

The next experiments were intended to show the effect on the evaporative power of the boiler of a break in the continuity of the iron by a flaw or join. In the one case the two parts of the metal were brought close together, in the other they were separated by a thin layer of foreign substance. Upon the face of the plate touching the water a sheet of steel $\frac{1}{16}$in. thick was placed, and a piece of tinfoil laid between the two surfaces. The whole was then heated, and as the tin melted the bolts holding the surfaces together were tightened and part of the tin squeezed out. Experiments carried out with the plate under these conditions showed that the temperature line in the diagram was almost parallel to that obtained with the single boiler-plate, except when the rate of evaporation was high. When 60lb. of water per hour per square foot of heating surface were evaporated, the temperature of the surface of the plate exposed to the fire was 392° above that of the water, and the author draws the conclusion that riveted boiler plates should never be exposed to too strong a fire, even when a perfect connection has been established between them. Flaws in the metal were imitated by strewing the interior surface of the plate with finely-powdered talc; the sheet of steel was then affixed and tightened on to the plate till the distance between them was only $\frac{1}{125}$ of an inch. The boiler was filled with distilled water, and with 30lb. evaporated per hour per square foot of heating surface the temperature of the plate exceeded 662°, being 270° in excess of that it had acquired when in direct contact with the water. With an evaporation of 50lb. all the plugs, even those filled with zinc, were melted; the temperature therefore exceeded 842°, and the plate was in danger of becoming overheated. This example exhibits the danger of flaws in that part of the metal nearest the fire.

A last experiment was made to show the effect of firebrick upon the evaporative power of the boiler. The furnace was filled with small pieces of firebrick, and the result showed that the transmission of heat to the boiler plate was not in any way affected by the presence of the bricks.

To exhibit the results of these experiments the author shows in one diagram all the different lines of temperatures obtained under the varying conditions described. Under ordinary circumstances the evaporation from a stationary boiler does not, at the point most liable to overheating, exceed from 20lb. to 28lb. per hour per square foot of heating surface, and can never with the strongest fire reach 50lb. The diagrams show that with distilled water and a normal evaporation of 20lb. to 28lb., the difference between the temperature of the water and that of the external surface of the plate next the flame varies from 135° to 153°. Even with 50lb. evaporation it is not 198°, and dangerous differences of temperature are only possible with the abnormal evaporation of 80lb. to 100lb. The largest difference representing the greatest danger of overheating was shown to be when the boiler was covered with a layer of plaster $\frac{1}{16}$in. thick, and when a flaw in the metal was imitated with powdered talc.

III. Under the third and last head the author proceeds to examine the important effect upon the transmission of heat of a thin layer of greasy substance interposed between the metal and the water. He covered the interior surface of the plate with mineral oil, which was then wiped off and left a greasy layer of no appreciable thickness, but sufficient to prevent the adherence of the water to the iron. The rest of the experiment was carried out in the ordinary way, and it was found that even when the fires were kept moderate the exterior surface of the plate was at a very much higher temperature than when the water came into direct contact with it. With strong flame the experiments gave two different results. In certain cases the increase of temperature corresponded with the increase of the intensity of the fire. The difference between the temperature of the water and of the flame surface of the plate was 90° higher than in the pure water experiments with an evaporation of 30lb. per hour per sq. ft. of heating surface. With an evaporation of 50lb. it was 144° higher, and the temperature of the flame surface of the plate was 360° above that of the water. In the second experiment with a moderate fire and an evaporation of 34½lb. all the alloys were melted, proving that the temperature of the plate had exceeded 842°. The effect of greasing the inner surface of the boiler is thus twofold; it either causes a moderate increase in the temperature of the heated surface, or with a fire of ordinary intensity the metal becomes heated to a dangerous degree.

The author next made a new departure in his researches. In order to watch the phenomena taking place at that part of the metal where the heat passes from it to the water, he took away the small boiler on which he had hitherto carried out his experiments, and substituted for it a small tinned iron saucepan, placed on the top of the furnace in the crucible. He had observed that where an abnormal elevation of temperature was attained in the experiments, black patches, apparently arising from the partial decomposition of fatty matter, adhered to the boiler at the beginning of the trial. Wishing to discover if they had any influence on the phenomena of the transmission of heat, he greased a clean tinned saucepan with mineral lubricating oil (*oléonaphte*), and heated it without water over a slow fire to decompose the fat. The bottom of the saucepan was found to be covered with black grease, to which water would not adhere. The saucepan filled with water was placed over the crucible, and fire applied beneath it. After boiling a minute one part at the bottom of the saucepan was seen to become red hot, and the incandescence soon spread over the rest of the area covering the mouth of the furnace. Evidently the bottom of the saucepan was never wetted at all, and the water was in a spheroidal condition. It is a most interesting sight, the author says, to observe the saucepan become red hot while the water is boiling above it, the tin of course being all melted. If the grease at the bottom of the saucepan is confined in one place, that part alone will become red hot at first, but the glow will soon spread over all the surface exposed to the heat. This experiment was repeated several times with flames of varying intensity. With heat corresponding to an evaporation of about 54lb. per hour per sq. ft. of heating surface, the colour of the bottom was bright orange; when 30lb. were evaporated it was dark cherry. The phenomena differ according to the kind of greasy matter on the surface.

From various experiments of this kind the author drew the following conclusions:—If a perfectly clean tinned iron saucepan is used, however intense the fire, the water boils in the usual way, and the tin is not melted. Nor is the surface affected by the heat when the saucepan is oxidised or covered with a thin layer of cold mineral oil. But if the oil is previously decomposed by heat, or if a rag smeared with this oil is laid at the bottom of the saucepan, overheating immediately takes place. The same effect is produced if a solution of salt

is burned in an oxidised saucepan, and the bottom, when covered with a thin crust of salt, is smeared with cold mineral oil. The smallest quantity of linseed oil at the bottom of the saucepan immediately produces overheating, even with the low evaporative power of 20lb. to 24lb. Spirits of turpentine or oil of turpentine do not cause overheating unless mixed with a minute portion of linseed oil. It is easily produced with red lead, but not so quickly with colza as with linseed oil. Valvoline when laid on cold only causes a dangerous glow when the heat is very intense, evaporating 70lb. Pitch at the bottom of a tinned saucepan floats off when the water boils; it adheres to an oxidised surface, but does not unduly heat the iron.

The results of these researches are summarised by the author as follow:—

1. A sound boiler plate, if in immediate contact with the water, does not in any part of its surface, even if exposed to a strong fire, acquire a dangerously high temperature.

2. The viscosity of the water does not prevent the boiler plate from being wetted, nor sensibly diminish the refrigerating power of the water.

3. If the boiler plates overlap, the transmission of heat is more or less impeded. Even a well-made joint ought not to be exposed to too fierce a fire.

4. A flaw in the thickness of a boiler-plate, or the least separation between two plates when bolted together, is almost sure, if exposed to too strong a heat, to cause injury to the boiler.

5. The contact of the flame with fire-brick is not dangerous if the boiler plate be in one piece and well wetted.

6. Any fatty deposit on the interior surface of a boiler plate greatly hinders the transmission of heat.

7. If the deposit is caused by a substance easily decomposed by heat, overheating is more likely to occur. Vegetable grease, therefore, as linseed or colza oil, seems in this respect much more dangerous than mineral oil.

Lastly, if a boiler be carefully fixed, kept clean, and filled with water, it runs no risk of burning even if the fire be strong. But if it is subject to great heat all precautions should be taken to eliminate everything which may hinder the transmission of heat through the thickness of the metal, or from the metal to the water.

Utilisation of Water Power.*

It has occurred to the author many times that the utilisation of water power has not received the amount of attention at the hands of the association to which it is entitled—indeed, he can find no paper bearing upon the subject. By placing a few notes before you it is hoped that the recital of your experience and suggestions may be conducive to the further utilisation of water power in the service of our towns and districts. The author casts the responsibility of this paper upon the association because no more experienced member has hitherto introduced the subject.

In using the term water power it must not be understood that of itself water has any power, any more than a spindle has; but it is necessarily acted upon by the energy of gravity, and being practically incompressible, is capable of transmitting power. It is only in this sense, therefore, that the term is used. If municipal engineers would take the trouble to investigate the available amount of water power in their localities for the purpose of applying it for the benefit of their districts, probably not a little advantage might be gained in many directions. Members of this association who have already requisitioned water power for municipal engineering would confer a great benefit on some of us by narrating the details and efficiency of such work. Our subject has practically nothing to do with the application of machinery to water, but that of water to machinery, except in so far as reference is made to hydraulic mains having an artificial head caused by the pumping of water under a load into mains, which in turn are to be used for motive power. Doubtless a convenient course will be to classify the subject under three heads: (1) sources of energy; (2) water motors; (3) application of power.

Sources of Energy.—Water is a source of energy which, unlike that of coal, is unaffected by strikes; neither is it a power which is ever likely to be more limited than it is at present. Vapour having been raised by the sun's heat, clouds are formed at various distances from the earth's surface. The rain falling from these clouds provides a power which it is the privilege of man to utilise. The higher the elevation of water above the sea level the greater the source of energy obtainable. When we consider that falling water is capable, theoretically, of performing just the amount of work which would be required to raise it to the height from which it has fallen, we can understand what an enormous available power exists in Nature for the working of machines. When water falls freely its descent will be accelerated in the same manner as that of falling solid bodies. It is, nevertheless, seldom that direct advantage can be obtained from this law, as most of the water falling upon the earth's surface sooner or later finds its way to channels and streams, the inclinations of which are slight and the beds rough, causing great friction. Wherever there is water there is power; and if we remind ourselves that about 3000 tons of water fall on every acre of area in England per annum, we see that it is no insignificant power which it is our duty to press into the service of man. Evidently only a proportion of this water can be profitably employed as a motor, as the falling rain has to serve other purposes in Nature. But, on the other hand, water can be used over and over again, being unlike steam in this respect, which, on leaving the cylinder, is evaporated. Perpetual motion is a demonstrated impossibility; but in a constant supply of flowing water, as in some stream which is never dry, we approach very nearly to the long-sought-for discovery.

It has occurred to the author that besides the power to be obtained from rivers, streams, waterfalls, lakes, tides, etc., small motors might more generally be driven from the water mains, sewage water, storm water, etc. In Market Harborough the pressure in the water mains is sufficient for working such machines as hydraulic lifts, there being a head of 200ft. This head is not sufficient for giving a proportionate efficiency as compared with steam for all purposes, but such a head might be utilised where the employment of other generating power would be out of the question. Mr. J. W. Sutcliffe, in the "Proceedings" of the Institution of Civil Engineers, says: "Every square mile of freely drained area of watershed in this district (East Lancashire and West Yorkshire) will furnish 0·2H.P. per ft. of fall (with very little storage), except during a few weeks in summer, when steam machinery is in its state of maximum efficiency." To take the greatest known source of water power in the world, we are told that the river Niagara has a total descent of 334ft., and discharges about 40,000,000 tons of water per hour, giving a horse-power of over 15,000,000—a power which it is difficult to conceive. At Bellegarde, at the confluence of the Rhone and the Valserine, on a fall of 40ft., 3700H.P. are utilised by six turbines. With respect to tidal power, the resultant opinion of a discussion at the Yorkshire College Engineering Society appears to have been that it had been somewhat over-estimated. The greatest possible advantage derivable from each acre of water 10ft. deep, reckoning a working day at eight hours, was stated to be 3¾H.P.

An example of unemployed water power may perhaps be here given. Eight years ago the author visited what was then, and is probably now, some disused machinery at St. Germains, in Norfolk. The works were constructed for draining low-lying land a few miles from King's Lynn, which is, as you know, at the mouth of the River Ouse. A channel was cut from the Ouse for a distance of 11 miles south of King's Lynn, and at four miles from the town a huge dam was thrown across the channel for the purpose of preventing the tide from flooding the low-lying country on its south side. At low tide it became necessary to liberate the accumulated water on the south side. To this end a series of 16 syphons, 3ft. in diameter, were conveyed over the dam, and protected from the damaging effects of drifting ice and timber by a large screen. To start the syphons it was necessary to exhaust the air within; and to accomplish this the vertical bodies of the syphons were connected by means of a tube attached to an exhaust pump driven by a stationary engine. The air within being sufficiently rarefied, the syphons commenced to act, and the pent-up water was conveyed over the dam. Taking the head of water to be discharged at 12ft., there was here a large available horse-power unutilised for the whole of the time during which the seven miles of channel were being emptied.

Water Motors.—To utilise the power existing in water in its natural channels, and under ordinary atmospheric conditions, as opposed to that from high-pressure water mains, many motors have been invented, and numerous modifications of these motors made. Water wheels, turbines, hydraulic rams, and water-pressure engines are the principal motors at present in use, these again being subdivided into innumerable types. The author has not the experience necessary to go very deeply into a comparison of the merits of the various types of motors, but he hopes that members present who have erected satisfactory machines will give particulars of such.

Molesworth gives the following theoretical horse-power of water:—

Q = quantity of water in cubic feet per minute.
h = head of water from tail-race in feet.
H.P. = theoretical horse-power.

$$H.P. = 0\ 00189\ Q\ h.$$

$$Q = \frac{528 H.P.}{h}$$

And the following effective horse-power for different motors:—

Theoretical power being	1·00
Undershot waterwheel	0 35
Poncelet's undershot waterwheel	0·60
Breastwheel	0 55
High breastwheel	0 6)
Overshot wheel	0·68
Turbine	0·70
Hydraulic ram raising water	0 6)
Water-pressure engine	0·80

Energy is due to three conditions of a head; corresponding to each of these three forms which the head takes there is a class of water motors. By a bucket waterwheel we can recover the energy corresponding to an unexpended part of the fall; by a pressure engine we can get the energy due to the pressure, and by a turbine we can get the energy due to the velocity.

Waterwheel.—This simple yet powerful motor was probably about the first machine invented by man for labour-saving purposes. Waterwheels are divided into two main classes—undershot wheels and overshot wheels. In addition, there are the breast waterwheels, which are a combination of the two.

Undershot Wheel.—In this wheel motion is generated by exposing obstacles to the action of a water current. The wheel is merely furnished with a series of plane surfaces, or floats projecting from its circumference, for the purpose of receiving the impulse of the water delivered under the wheel. The power is communicated from the spindle upon which the wheel revolves. As it acts chiefly by the momentum of the water, the weight of the water being scarcely called into action, it is only proper to be used where there is a great supply of water always in motion. It is the cheapest of all waterwheels, and is more applicable to rivers in their natural state than any other form of the wheel. It is also useful in tide currents, where the water sets in opposite directions at different times, because it receives the impulse equally well on either side of its floats. The effective horse-power of undershot waterwheels = 0·00066 $Q\ h$. Quantity of water in cubic feet per minute $= \frac{1511 H.P.}{h}$.

The Persian wheel, which is a modification of this wheel, is a simple apparatus for raising water. A number of buckets, movable about an axis above their centre of gravity, are suspended to the rim. As the wheel goes round the buckets enter the water in succession, and are carried up full. When they reach the height of the diameter of the wheel they strike against a fixed obstacle, so as to tilt over and empty their contents into a spout or reservoir placed to receive them. It is generally used in connection with a system of irrigation.

Poncelet's undershot waterwheel is a much more serviceable machine than the common type, the flat floats in the latter being replaced with curved floats, which take up the impulse of the water to a greater extent, and also present a greater surface to the current. The effective horse-power of this machine = 0·00113 $Q\ h$. Quantity of water in cubic feet per minute $= \frac{880 H.P.}{h}$.

Overshot Wheel.—The periphery of this wheel is provided with buckets or receptacles, the water is delivered from above, and is retained during a part of the descent. The buckets on one side being erect, will be loaded with water and the wheel will be thus set in motion; the mouths of the loaded buckets being thus turned downwards by the revolution of the wheel, will be emptied, while the empty buckets are successively brought under the stream by the same motion, and filled. In this wheel the weight as well as the momentum of the water is used, and a much greater power is therefore produced with a less supply of water than is necessary for the undershot wheel. The effective horse-power of overshot waterwheels = 0·00128 $Q\ h$. Quantity of water in cubic feet per minute $= \frac{777 H.P.}{h}$.

(To be continued.)

* Paper by H. G. Coales, read at the annual meeting of the Incorporated Association of Municipal and County Engineers at Bury, July, 1892.

Trade Notes.

It has been decided to erect a new pier at Morecambe. It is estimated to cost between £25,000 and £30,000.

An electric tramway on the Thomson-Houston overhead system is being erected between Jeuceppe and Tilleur, Belgium.

An electric tramway has recently been completed by Messrs. Ganz and Company, of Budapest, in the works of the Bleiberg Foundry Union, at Bleiburg.

It is stated that Messrs. Krupp, of Essen, have arranged with the Russian Government to establish works for the manufacture of Krupp guns in the south of Russia.

The directors of the Lancashire and Yorkshire Railway Company have decided to recommend a dividend for the past half-year at the rate of 3½ per cent. per annum, carrying forward a balance of about £20,000.

The directors of the Bristol and South Wales Railway Wagon Company Ltd. recommend the payment of a dividend for the half-year ended June 30 last, at the rate of 10 per cent. per annum, with a bonus at the rate of 5 per cent. per annum, free of income tax.

The Vestry of St. Pancras, London, are about to carry out an extension of the electric light at a cost of £4750. The cost of the lighting up to the present has been £60,000, in addition to £10,000, the cost of the land.

The directors of P. and W. MacLellan Limited have declared an interim dividend of 6s. per share, less income tax, being at the rate of 6 per cent. per annum, payable on August 11, to shareholders registered on July 30.

The entrance hall and the new extensions of the City Art Gallery, in Mosley-street, Manchester, are being installed with the electric light. The work is being carried out by Messrs. E. J. Dugdill and Co., of Failsworth, Manchester.

Messrs. A. Findlay and Co., Motherwell, are constructing a three-span steel plate girder bridge at Crossmolina, for the grand jury of County Mayo. Each span will measure 37ft. in length. The amount of Messrs. Findlay and Co.'s tender was £3373.

Messrs. Thomas Hill and Co. inform us that they have been appointed sole representatives in Scotland to the Bowling Iron Company Limited, Bradford, for the sale of their Capell (patent) fans and engines for mine ventilating.

At the Crystal Palace Electrical Exhibition, a prize medal has been awarded to Mr. John Spencer, of the Globe Tube Works, Wednesbury, for his exhibit of iron tubes and fittings for electric lighting purposes, up to 8in. diameter, telegraph poles, tubes for Brook's and Ferranti's system, etc.

The directors of the Midland Railway Company will recommend to the proprietors a dividend on the ordinary stock for the past half-year at the rate of 5¼ per cent. per annum, carrying forward £14,000. For the first half of 1891 the dividend was at the rate of 5⅜ per cent. per annum, and £14,592 was carried forward.

Messrs. Fleming and Ferguson, shipbuilders and engineers, Paisley, launched on the 27th ult. one of two twin-screw 1000-ton hopper barges which they are constructing for the Clyde Trust. Her dimensions are 200ft. by 34ft. by 15ft. 6in. She is to have a hopper capacity of 20,000 cubic feet, and will be fitted by the builders with two sets of triple-expansion engines to indicate 1000H.P.

The directors of Ferry and Co. Limited, steel pen makers, have resolved to pay on the 1st September an interim dividend on the ordinary shares for the first six months of this year at the rate of 10 per cent. per annum, free of income tax, being at the same rate as for the corresponding period last year. The half-yearly dividend on the preference shares will be paid as usual, at the fixed rate of 5 per cent. per annum.

By the way of offering facilities for the Atlantic mail traffic, a company has been formed at Bristol, under the title of the Bristol Ocean Mail Company, with a capital of £200,000, to provide low-water piers at Portishead. The money has been subscribed by London and American capitalists, and there is a strong Bristol Committee connected with the undertaking. Messrs. Pearson and Sons, London, have secured the contract, and operations will be pushed forward at once. The pier will be a third of a mile long.

Wheel cutter in metal only. Every description of gearing. R. Chidlaw, 43, City-road, Manchester.

Modern tools, standard quality, are the cheapest. Apply Britannia Tool Factory, Colchester, and 100, Houndsditch, London.

Having regard to the enormous circulation of The Mechanical World, the Editor suggests that it is by far the best medium for the insertion of every kind of "Wanted" advertisement, and the price is only one half-penny per word. The Editor will be glad if Mechanical World readers will kindly bear this in mind as occasion arises.

Sugar-making Machinery.--XVI.

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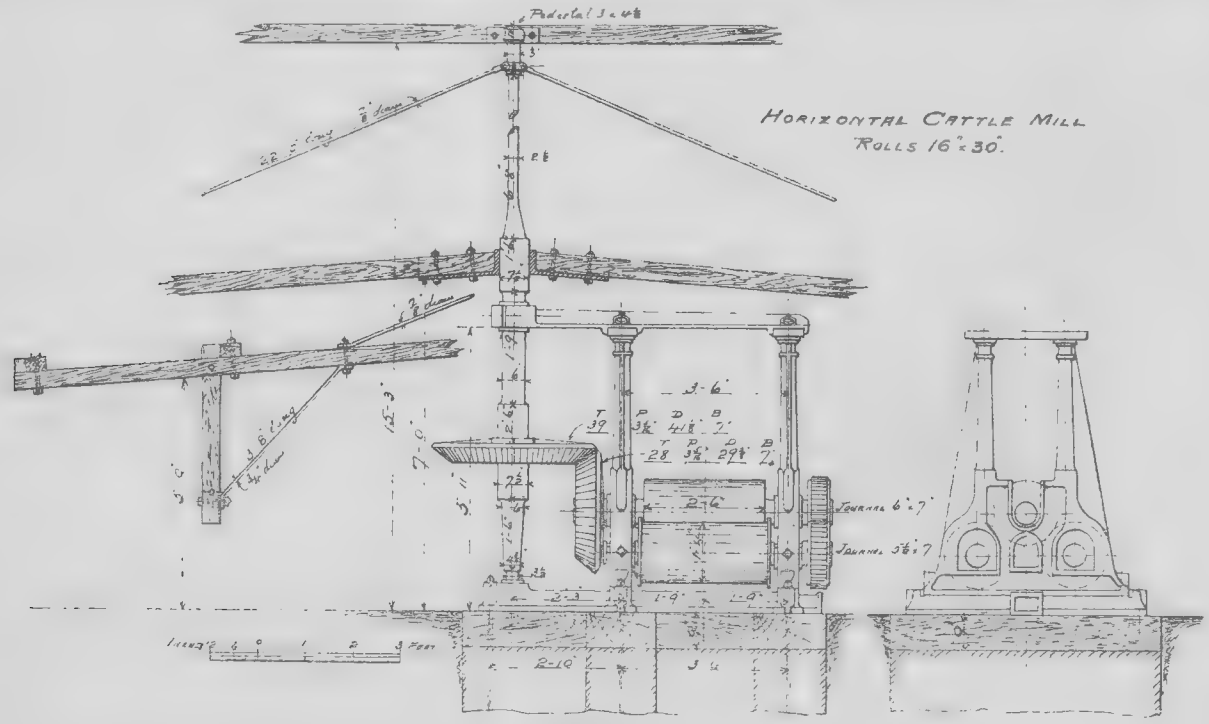
THE opening between the two receiving rollers is 10 per cent. of the thickness of the layer of canes. The opening between the top and the megass rollers is 10 per cent. of the other opening.

Experience would seem to show that the best results are obtained by slow crushing, although opinion is somewhat divided as to the best speed. In one case, with a speed of 8 revolutions per minute, only 46 per cent. of the juice was extracted, and when the speed was reduced to 2½ revolutions the yield was increased to 70 per cent.



SUGAR MACHINERY.—FIG. 31.

The best speed for large mills may be taken at from 12ft. to 16ft. per minute of roller surface, and for small mills from 16ft. to 20ft. per minute. For medium-sized mills the number of revolutions may be got approximately from this formula :— $N = \frac{66}{d}$. N = number of revolutions per minute, d diameter of roller in inches.

The following table gives the usual number of revolutions per minute for various sizes of rollers :—

TABLE VI.—SPEED OF CANE ROLLERS.

Dia. of Roller in in.	Cube of Dia.	No. of Revs. per min.	Dia. of Roller in in.	Cube of Dia.	No. of Revs. per min.
12	1,728	7	30	27,000	1·92
14	2,744	6	32	32,768	1·8
16	4,096	5	33	35,937	1·8
18	5,832	4·5	34	39,304	1·7
19	6,359	4	36	46,656	1·6
20	8,000	3·5	38	54,872	1·5
22	10,648	3·125	40	64,000	1·4
24	13,824	2·8	44	85,184	1·2
26	17,576	2·2	48	110,592	1·1
28	21,952	2			

The length of the rollers is usually 1½ to 2 times the diameter, or 6 times the diameter of the gudgeon.

The diameter of the gudgeon (wrought iron) is approximately = $\frac{\text{dia. of roll in in.}}{2·5}$.

The mean thickness of the roller cases varies from ⅛ in small to ⅛ in large mills, where the lengths of the rollers are proportioned to the diameter as above.

The horse-power required to work sugar mills is very considerable, and in order to keep down the size of the engine as small as possible, the power has to be multiplied many times. This used to be accomplished by means of single gear, consisting of a very large spur wheel on the top roller gudgeon, driven by pinion on engine shaft. The more modern practice is by means of double gear, the multiplying power varying from 12 to 40 times in some mills; from 20 to 28 is the most general ratio.

An approximate rule for the horse-power required for sugar mills of moderate size is the following :— I. H. P. $= D^3 \times 0·00274$, where D = diameter of roller in inches, the length of the roller assumed from 1½ to 2 times the diameter, and the speed as in table above.

Example.—Find approximate horse-power for a three-roller mill, rolls 30in. diameter by 60in. long $= 30^3 \times 0·0027 = 27,000 \times 0·0027 = 72·9$ I.H.P. We may here also give a useful rule employed by some makers, in which the length of the roller is a factor. D = diameter of roller in inches, L = length of roller in inches. Then I.H.P. required $= D^2 \times L \times 0·001367$ at a surface speed of roller of 18ft. per minute.

The quantity of juice expressed by rollers of a given size is given approximately by the rule proposed by Mr. John McNeil in the "Sugar Cane" some years ago, which is as follows :—Gallons per min. $= d^2 \times L$, where d = diameter of rollers in feet, and L = length of rollers in feet. Gallons per hour $= 60 \times d^2 \times L$.

Example.—How many gallons of juice will a mill having rollers 30in. diameter by 60in. long express per hour : $= 60 \times 2·5^2 \times 5$, or $60 \times \frac{30}{12} \times \frac{30}{12} \times 5 = 187·5$galls.

per hour. This rule gives fairly approximate results for purposes of calculation. The amount of juice which any mill can extract depends on many things—the richness of the juice in the canes, their hardness, the nip or pressure given to the rolls, and the power available for driving the mill.

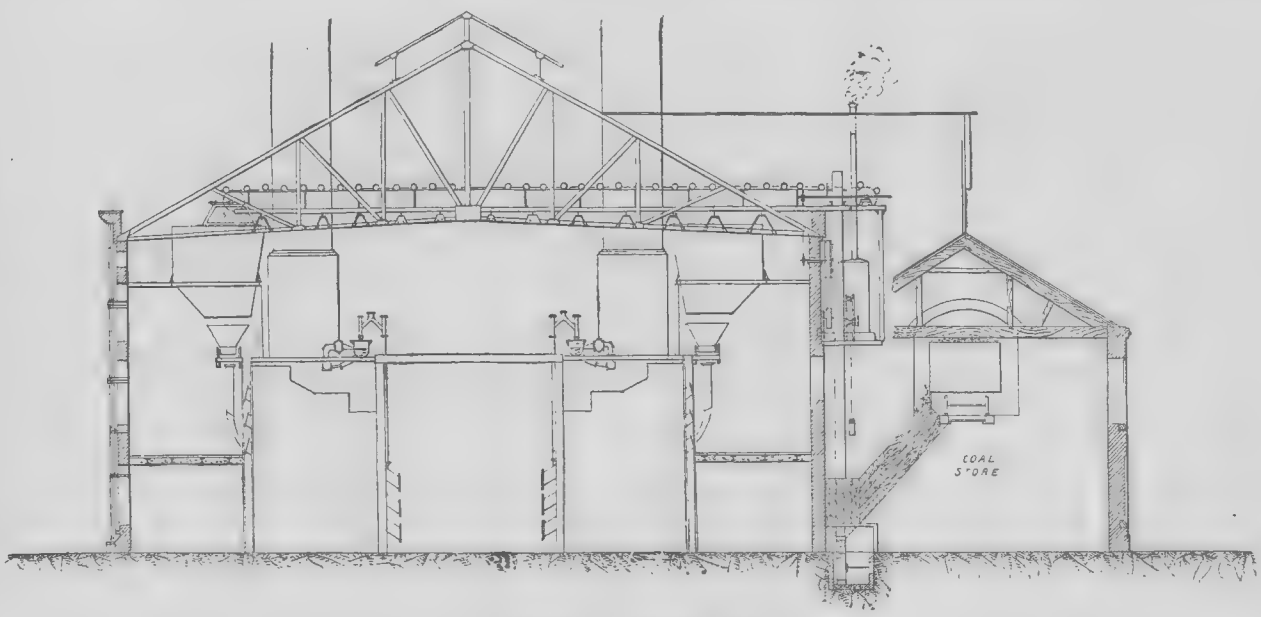
The amount of canes which mills can conveniently handle is given by the following formula : $C = D^2 \times L \times 0·00276$, where C = tons of canes used in 12 hours at 7 per cent. extraction, D = diameter of rollers in inches, L = length of rollers in feet.

Table VII. gives the quantity of canes crushed by various sized mills, and the quantity of juice expressed by the rule given.

stability from the great weight of the rollers, headstocks and bedplate. A large bevel wheel is keyed on the vertical shaft, which gears into the pinion on the top roller gudgeon, the motion being communicated to the other rollers by means of the pinions on the opposite side of the mill. These pinions are generally of tough cast iron, sometimes of cast steel; the top roller pinion is usually flanged to the points of the teeth on one side to give additional strength.

Between the two side rollers and under the top roller is fitted a strong bar, called the "trash" turner, generally a rectangular cast-iron bar resting in the cheeks or on brackets cast on the inside. They are also made of T-section, and square bars of wrought iron are sometimes used in large mills. When of cast iron they are generally faced with a wrought-iron or steel plate or knife, fastened by means of bolts or screws. Illustrations of various types of "trash" turners will be given later on. The function of the "trash" turner is to guide the partly crushed canes from the front roller to the back roller for the final squeeze. Owing to the choking which often takes place the pressure which comes on this bar is sometimes very great, and hence the necessity for making it exceedingly strong.

In the illustration the cattle cross is made to take three poles (they vary from one pole in the small to as many as five in the large mills), two oxen being yoked to the ends. The poles, when long, are trussed as shown, the vertical spindle



AUTOMATIC GASWORKS.—FIG. 1.

The smaller sizes of the three roller mills are mostly driven by means of oxen or mules yoked to a long pole attached to a cattle cross fixed to the vertical driving spindle in Fig. 31. This type of mill is well suited for small farms, or for situations where cane is grown only on part of the estate, and where the cattle power is thereby utilised at a time when it is not available for other purposes. It will be seen that the gear is attached to the mill framing, and derives being extended upwards, the end being carried in a pedestal bolted to a cross-beam placed at a convenient height. The cattle path should not be less than 40ft. in diameter, so as to give the best results. The path in the mill illustrated is 56ft. in diameter. The useful effect of a horse or ox is less when walking in a circle than when pulling a load on the straight. An ox walking in a circular path will travel on the average about 117ft. per minute, or 1·33 miles per hour; hence in the case given it will make the revolution in $\frac{176}{117}$ = 1·5min.

The average pull of an ox under the conditions stated is, according to Morin,

TABLE VII.

Rollers. Dia.	Rollers. Length.	Gallons Juice per minute.	Tons of Canes used per 12hrs.
12	24	2·0	9·43
14	20	2·27	10·3
16	24	3·56	17·0
18	30	5·64	27·0
20	36	8·35	39·7
22	42	11·8	56·0
24	36	12·03	57·0
24	48	16·03	76·0
24	54	18·04	86·0
26	48	18·82	90·0
26	54	21·17	100·0
26	66	25·88	123·0
28	54	24·55	117·0
28	66	30·0	143·0
28	72	32·74	156·0
30	60	31·32	150·0
30	66	34·45	164·0
30	72	37·58	180·0
32	72	42·76	203·0
32	84	50·0	238·0
34	72	48·3	230·0
34	78	52·3	250·0
36	84	63·0	300·0
40	78	72·4	344·0

145lb. = 16,930ft.-lb. per minute. The combined horse-power for the six oxen will therefore be $\frac{16,930 \times 6}{33,000} = 3$. The moment of the pull on the shaft will be $145 \times 6 \times 28 = 24,360$ft.-lb. $= 292,080$in.-lb. The moment of resistance of a wrought-iron shaft to twisting is expressed by the formula $M = \frac{\pi}{16} f d^3$, where f = ultimate tensile strength of material, d = diameter of shaft in inches, M = moment of resistance.

Taking $f = 50,000$lb., we have $M = 0·196 fd^3 = 2,116,800$in.-lb. The factor of safety in this case is therefore $\frac{2,116,800}{292,080} = 8$ nearly.

The pressure on the teeth of the bevel wheel will be approximately $\frac{292,080}{18} =$ 16,226lb. (18 = mean radius of large bevel wheel in inches.) As two teeth may reasonably be assumed as in contact at the same time, the load on one tooth will be $\frac{16,226}{2} = 8116$lb.

The thickness of tooth required may be calculated from the following formula :— $t = \sqrt{\frac{S L}{800 \times B}}$, where t = thickness of tooth in inches, S = safe load on one tooth, L length of tooth in inches, B = breadth of tooth in inches.

Assuming length of tooth to be 2·38in. and the breadth 7in., we have $t = \sqrt{\frac{8116 \times 2·38}{800 \times 7}} = 1·5$in. Allowing for clearance, the pitch will be approximately $2·2\,t = 3·3$, from which it will be seen that the pitch given is sufficient. The teeth will have additional strength by being flanged to the pitch-line.

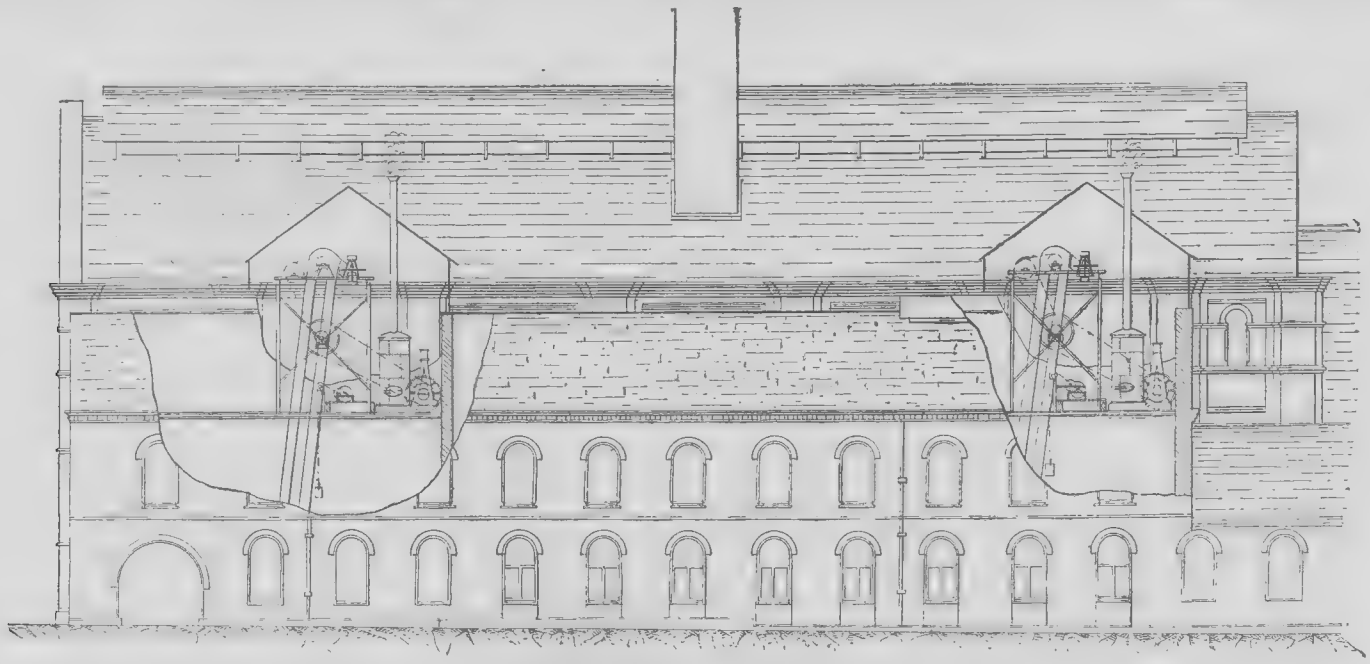
(To be continued.)

An Automatic Gasworks with Little's Patent Conveyors.

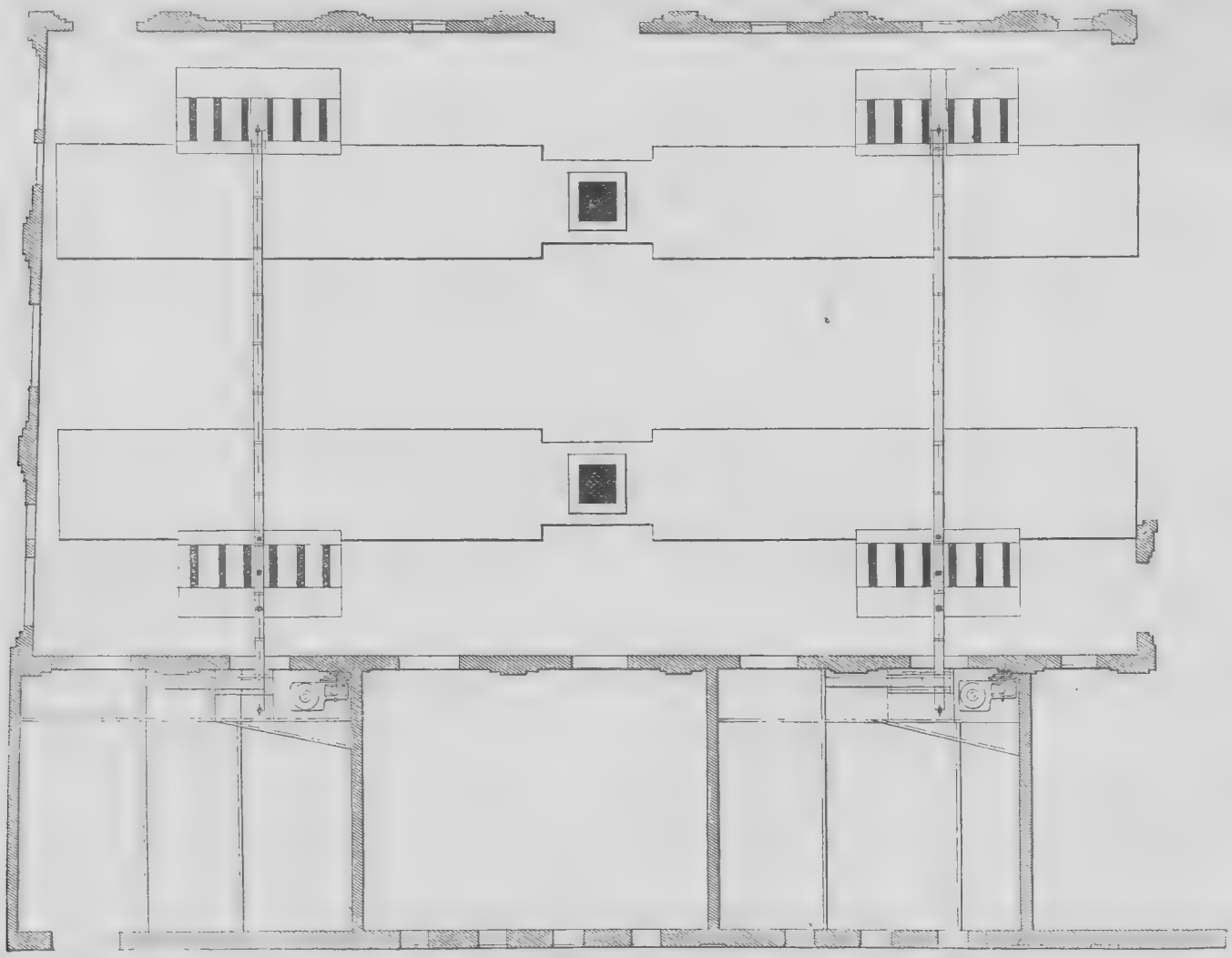
It is a matter of common knowledge that every industry is occasionally visited with an outbreak of inventiveness on the part of those who are engaged in it. The gas industry is just now in this position; for it may be safely stated that among gas engineers and managers there is, at present, almost a universal desire for improvement and economy in the retort house. Their chief object is to obtain machinery to supersede manual labour, and, in the severe work of charging and drawing retorts, make the men merely attendants of appliances which will produce altogether superior results. Our readers are familiar with the special activity which during recent years has been directed to the solution of the problem of the automatic charging and discharging of retorts, and the mechanical manipulation of the coal and coke by means of conveyors and elevators. But the accompanying illustrations of the new retort house at the Coventry Corporation Gasworks, where there are 154 inclined retorts, equipped throughout with Little's automatic conveyors and elevators by the New Conveyor Company Limited, show perhaps one of the most complete self-feeding arrangements at present in operation in this country.

Prior to building the new retort house, a series of exhaustive tests were made on an experimental setting of six inclined ∩ retorts, each 21in. by 15in., and 15ft. long. During the tests with the trial setting, many changes were made, and various heats tried, and eventually it was found that, however the retort might buckle in the heating, the even distribution of the coal and the free running out of the coke were effected without the drawbacks and the manual attention required in some of the prior tests made on inclined retorts at other gas and chemical works. This success was in a large measure due to the fact that the regenerative arrangement of heating adopted in the experimental setting was Winstanley's patent furnace; and the advantages gained were that only 10lb. of coke were used per 100lb. of coal carbonised, and a uniform distribution of heat was obtained throughout the entire setting at a very high temperature. These advantages made it possible, during the trials, to carbonise 7cwt. of coal every six hours; being 28cwt. per day per retort, or 8 tons 8cwt. per bench of six. With such results as these, it cannot be matter for surprise that it was immediately decided to have the new house (which is shown in section in Fig. 1 of the accompanying illustrations) fitted throughout with inclined retorts. The buildings are exceptionally handsome for a retort house, and—a point which we think of more importance—they are particularly wide and lofty; thereby ensuring the most perfect ventilation. The house, which is built of red brick, is 74ft. span and 127ft. long. The roof is in one span—the principals being 20ft. apart; and the trussing adopted is composed chiefly of flat iron.

To enable our readers to clearly follow the illustrations, we now proceed to describe the manipulation of the coal from the time it is shot from the wagon, as shown, into the receiving hoppers over the coal crushers, until the coke is distributed automatically into the yard. Referring to the illustrations, it will be seen that a line of railway extends up the length of the coal stores, in which two elevators are arranged with receiving hoppers, having coal breakers fixed over the elevator boots. The coal is shot from the wagons into the hoppers, and is fed by the breakers into elevators. The elevators, which are of Little's design, made by the New Conveyor Company Limited, with flat and round steel links, and steel buckets enclosed in dust'ess steel casing, lift the coal to the two cross conveyors, which in turn deliver it into the four large storage tanks fixed at each corner of the house. The conveyors are of Little's patent noiseless design (illustrated in The Mechanical World, June 24), with steel troughs, and push-plates carried on guide pulleys to prevent the plates from touching the sides or bottom of the trough. The coal tanks hold 40 tons each—being a sufficient quantity for the night's supply; so that the machinery requires to be run during the day shift only. The tanks are of special design, the sides being all of one steel plate, bent to position by heavy hydraulic machinery at the works of the New Conveyor Company. In the bottom of each tank are fitted six doors through which the coal passes to a portable charging tank, arranged to hold six charges of 8½cwt. each. In the new retort house now being erected at Gateshead for the North-Eastern Railway Company, there is a stationary tank the entire length of the house, with divisions over every retort, holding the necessary charge for each. Above this



Automatic Gasworks.—Fig. 2.



Automatic Gasworks.—Fig. 3.

tank an improved noiseless steel-rope push-plate conveyor is fixed, to trim the coal into each of the divisions. The elevators for the coal at Gateshead have, Mr. Little, the managing director of the New Conveyor Company Limited, informs us, also been arranged to lift the coke to the wagons—a twin arrangement which he thinks is novel in a gasworks. The portable tank serves the same purpose as the long stationary tank at Gateshead. This tank is moved along the rails by means of a chain and chain wheel pulled from the charging stage. The doors in the bottom of the portable tank are opened and closed from the same stage, so that the labourer charging the retorts has everything at his hand. Under the tank three steel shoots run on rails, and conduct the charges to the three tiers of retorts. As the coal falls down the inclined retort, it is checked by a plate inserted a little way up the retort. This plate prevents the coal from running down to the discharge mouthpiece; and at the same time it forms a stop for the flow of coal, so that an even depth of coal is distributed automatically over the complete length of the retort. Large pieces of coal, as well as the dust, are deposited evenly in the retort. The velocity of the flow of the coal as it falls from the portable tank through the movable shoots is regulated by means of a weighted swing flap, and after the coal passes this flap door it is further regulated in flow by a check fixed on the delivery point of the shoot. In the charging mouthpiece is placed a shield, to give a smooth face for the coal to flow over into the retort. The charge having been put into the retort in the manner already described, the shoot is withdrawn, the mouthpiece with self-sealing lid is closed, and the portable tank moved to the next or any other setting, the whole operation of charging a retort not occupying more than five seconds by an ordinary labourer. When the coal is carbonised, which in this particular retort house is done in about six hours, the lower mouthpiece is opened and the stop-plate removed, and the coke then slides out. The angle of the retorts varies from 30° to 31½° in the different tiers, the top range of retorts being, of course, at the greater angle, to compensate for the shorter fall from the portable coal tank. At present the coke slides into an iron truck; but plans have been prepared showing an arrangement of Little's patent endless steel-rope coke conveyors with an inner trough, travelling in a fixed jacketed water trough. The hot coke falls direct from the retort on to the moving trough, and thus wear and buckling are prevented. Besides this, the quenching of the coke is partly effected as it moves along through the water trough. Mr. Little informs us that his new coke conveyor was designed to the order of Mr. W. Foulis, of Glasgow Corporation Gasworks, where a very successful installation of Little's conveyors is at work. In the extensive arrangement of patent conveyors at Coventry Gasworks, the coke is carried by them along the passage, where the clinkers are also removed. On reaching the end of the passage, or tunnel, the coke under the discharging stage is shot by the fixed conveyor into an elevator, which lifts it to a conveyor at a height of 30ft. to 40ft., which distributes it all over the yard. As will be seen from our drawings, the automatic conveyor plant at Coventry Gasworks is duplicated. The two vertical engines and boilers were supplied by Messrs. Barry, Henry and Co. Limited, engineers, founders, and millwrights, Aberdeen; as Mr. Gilbert Little is the London director of Barry, Henry and Co. Limited, as well as managing director of the New Conveyor Company Limited.

The Marine Boiler, Past and Present.

(*Continued from page* 27.)

In the combustion chambers, as you are all aware, and especially at the sides, where they are stayed, is generally where scale accumulates. Scale in the boiler is what I might be allowed to call a necessary evil; from the fact that no fewer than 200 patents and an innumerable number of anti-incrustations have all proved to be more or less failures is the best evidence of the magnitude of the evil they would overcome. Scale not thicker than $\frac{1}{32}$in. may be regarded as an advantage in forming a coating to protect the heating surfaces of the boiler against the corrosive action of some waters; in other cases, where the boiler has been kept too clean, they have been found to be dangerously corroded internally. Weir's evaporator is specially designed for the prevention of scale forming on the heating surfaces of the marine boiler. In all cases where I have examined boilers, and where Weir's patent evaporator is used, the scale was found to be not more than $\frac{1}{16}$in. in thickness; and in nearly all cases the chipping off of the scale was not necessary, it forming the desired coating of the heating surfaces. To overcome the difficulty of the combustion chamber as regards the stays and to assist in cleaning, a firm in Liverpool, I believe, has patented what is called a cylindrical combustion chamber. It is of an oval shape, and is corrugated all round, except the back and tube plate, in the same manner as Fox's corrugated furnace, thus avoiding the necessity for stays. The bottom of the combustion chamber is in a line with the centre of the furnace, the connection between the two being made by a circular deadened plate. By this arrangement brickwork in furnaces for bridges is done away with. Within the last two or three years, it seems to me that competition between makers and patentees of furnaces for marine boilers has been very keen, and more especially between the makers of Fox's corrugated furnace and Purves' ribbed furnace. Fox's furnace being the first of the two in the market the demand for it was very great, so much so that over 12,000 furnaces have been applied to boilers of all forms, their advantages being so great over the plain furnace which was the only form of furnace practically in use at the time of their introduction. The corrugated furnace has enabled us to use higher pressures (before utterly impracticable), ranging from 100lb. to 180lb. with furnaces only $\frac{3}{8}$in. and $\frac{9}{16}$in. thick, and as large a diameter as 4ft. 8in. The use of the corrugated furnace to avoid collapse has been proved, for on an average it is four times stronger than a plain furnace. In an experiment with two furnaces, each 3ft. 2in. diameter and 7ft. 4in. long, both of $\frac{3}{8}$in. plate, having sound welded joints and perfect in every way as to material and workmanship, the plain furnace totally collapsed at 225lb. per sq. in., while the corrugated furnace stood 1020lb. per sq. in. before collapse set in; and a series of trials proved that even when flattened to the extent of 15in. in both sides, the furnace will bear 450lb. before moving on further to collapse. They are made of very mild steel, of a tensile strength of about 23 tons. The steel from which they are made is first cast into ingots, and then put into a peculiar furnace. The heating agents used in these furnaces are gas and air; the air is driven into the furnace by means of a jet of steam directed down a tube, the gas being admitted in a certain proportion to a large percentage of air. A very small quantity of coal is used, just sufficient to keep the oxygen in the air and gas alive. The plate, after being rolled out to the desired thickness, is bent or rolled cold to the required diameter, bringing the two edges together; a strong and perfect joint is made by a combination of three welding machines. The blow-pipe is used for welding, being supplied in proportion with five of air and one of gas. In a brief space of time the whole length of the joint is brought to welding heat, and then run under a patent travelling steam-hammer. I have no doubt many of you have examined some of these welds; you can hardly distinguish them from the solid plate. After being welded they are corrugated. It has been said that scale will not adhere to a corrugated furnace; but I have found scale on corrugated furnaces quite as much as on any plain furnace, and it is more difficult to remove. Of quite recent date Purves' ribbed furnaces seem to have taken the place of Fox's corrugated furnaces. The demand for Purves' ribbed furnaces at the present time far exceeds that of Fox's. A plain furnace, say 3ft. 6in. diameter (according to Lloyd's rule), and $\frac{7}{16}$in. in thickness, will stand a working pressure of 83lb. per sq. in. One of Purves' ribbed furnaces, the same diameter and thickness, will stand a working pressure of 138lb. per sq. in. Neither Fox's corrugated furnace nor Purves' ribbed furnace is recognised by the Board of Trade as a longitudinal stay in the boiler the same as a plain furnace is, hence the reason they are always found surrounded with solid stays, from tube-plate to tube-plate, and from end to end in double-ended boilers. The smallest thickness rolled of Purves' furnaces is $\frac{7}{16}$in. for 6, 7, 8 and 9 ribs, any diameter from 2ft. 4in. to 4ft. 4in., made of one plate, with one weld running along the bottom of the furnace. In patching Fox's iron corrugated furnaces it was found to be very difficult; in fact, almost impossible to make a good sound job. In patching plain furnaces there is a difference of opinion as to which side of the plate to put the patch on. My opinion is that the patch should be put on the inside of the furnace—that is to say, the side next to the fire. In time the patch will crack from the edge of the plate into the rivet holes, which will cause it to leak, and will require to be renewed; in nine cases out of ten the patch only will require to be renewed, whereas if the patch is on the outside of the furnace the edge of the furnace plate will crack similar to the patch, which will cause the hole in the furnace plate to be cut larger, and in time will cause the furnace crown plate to be cut out and renewed. In marking off the rivet holes for a patch the corner holes should always be kept in a line with the other holes. In the event of one side of the patch leaking and not the other the one side only could be cut; whereas if the corner holes are not kept in a line with the others, and one side of the patch leaking, it would be necessary to cut the hole larger all round. Patching is now becoming a thing of the past, since the mild steel plates are used for all heating surfaces of the marine boiler. There is no lamination or blistering with steel plates. Purves' ribbed furnace, to which I have previously referred, has not been long in use, but up to the present time over 3000 furnaces have been manufactured for this and other countries, and their progress must be encouraging both to the patentee and manufacturer. Steam boilers were long ago recognised by some of the highest scientific authorities, but it is only within a recent period that they have received much attention from the practical engineer. This, perhaps, is due to the fact that foreign competition has only recently made itself felt; and therefore economy in every department has to be studied to enable us to compete successfully with our foreign rivals. While much credit is due to inventors for their ingenuity, yet probably still greater credit should be due to those who perseveringly work for their practical and successful adoption. There is, unfortunately for many of us, as working-men, such great barriers to be surmounted that it is to be feared many important inventions never reach maturity. There has been quite recently introduced into the engineering world what is called the "Serve" tube for marine boilers. You will see by the drawing which is before you how it is constructed—similar to a plain tube on the outside, and with a series of ribs, seven or eight in number, running parallel with the shell along the inside of it. The most unfavourable conditions for the Serve tube, when in use, are said to be a low natural draught and very smoky coal. Small steamships with short funnels are unable to use them. Steamships with high funnels, or with induced or forced draught, are suitable. For natural draught, a height of funnel 65ft. in height from firegrate to top of funnel is deemed necessary with coal—say Welsh, or an equivalent quality of coal; and for smoky coal, a funnel 75ft. in height. With these conditions, the makers guarantee that the Serve tube will give no trouble. In re-tubing boilers and substituting the Serve tube for the plain one, at least 10 per cent. of coal will be saved by keeping or making the funnel the desired height; or if the cold air feed draught be increased, so as to burn the same quantity of coal as previously, with the plain tube at least 10 per cent. increase in the evaporation will be produced by the same consumption of coal. Although 10 per cent. is all that is guaranteed, greater economy will be obtained with cold air feed, with a draught of $\frac{7}{16}$in. vacuum at the base of the funnel, when Welsh coal is used, or at a draught of $\frac{1}{2}$in. vacuum with inferior coal. At a draught of $\frac{3}{4}$in. vacuum 15 per cent. increase in the evaporation will be obtained. Boilers fitted with cold air draught, and with the combination of the Serve tube and what are called Howden retarders, will give at least 12½ per cent. over a plain tube fitted with a retarder, and 20 per cent. over a plain tube by itself. With hot air feed the economy is less. The above figures are the outcome of many experiments made at the works of the makers—Messrs. John Brown & Co., Sheffield. They are in the boilers of the s.s. "Ratho," belonging to the Caledonian Steamship Company, Liverpool, which has just completed her first voyage to Rangoon and back to Liverpool. They are worked with natural draught, the height of funnel from firegrate being 74ft.; and according to the copy of testimonial from the owners, which is lying on the table before you, they seem to have given no trouble during the voyage, and fully realised the advantages guaranteed by the makers. At the present time the Cunard Line are obtaining experience with the Serve tube in the s.s. "Aleppo"; also the Inman Line with their steamer the s.s. "Pennsylvania," in both cases Howden's forced draught being used in conjunction with the Serve tube. In these two ships the trials are against plain tubes with Howden's retarders.

(*To be continued.*)

Telephonic communication will shortly be established between Worms and Frankfort, and Darmstadt and Mannheim.

Metal Trade Memoranda.

Messrs. Vickers, of Sheffield, have recently made a steel casting, weighing 95 tons, in one piece.

The Poldi-Hutte Cast Steel Works at Kladno, Austria, have secured an order for 25,000 cast-steel rifle barrels for the Italian War Department.

Messrs. John Abbot and Co., of Gates-head, have commenced the manufacture of a new stockless anchor, which is said to possess special advantages.

Messrs. Macfarlane, Strang and Co., Possilpark, have secured a contract for the supply of 600 tons of cast-iron pipes to the Glasgow Corporation.

The Government of New South Wales have decided to call for tenders for 175,000 tons of steel rails, to be manufactured within the colony from material obtained in the colony.

The directors of the Consett Iron Com-pany have resolved to recommend to the ordinary general meeting on August 13 the payment of a dividend of 12s. 6d. per share on the ordinary shares, and 2s. 5d. per share on the 8 per cent. preference shares.

Mr. Waterhouse's return made to the Northern Iron Trade Conciliation Board on the 26th ult., gives the average net prices of rails, plates, bars, and angles for May and June at £5 9s. 9d., an increase of 6d. per ton. The production, 19,000 tons, was a diminution of one-half compared with the corresponding period, through the late Durham colliery strike. The chief decline was in plates, manufactured. There is no reduction upon this ascertainment in ironworkers' wages by the sliding scale, which went up 25 per cent. in prosperous times, and of which 12½ per cent. was subsequently lost.

With reference to the Puhipuhi silver field in New Zealand, Mr. A. Mackay, the assistant Government geologist, has presented a report, in which he states that his examination has led him to conclude that the field forms a part of the mineralised region extending along the east coast of the Auckland peninsula both to the north and south of the limits of this field. The quartz reefs are well defined, and prove themselves that they live through a vertical depth of 500ft. to 700ft., while there can be no doubt that they continue to a great depth below the drainage levels of the country. Almost all the reefs contain silver ore more or less. The average percentage of ore taken out at present is not sufficient to enable it to be treated profitably, but Mr. Mackay still believes that there is a great future for Puhipuhi and the adjoining district as a field for mining enterprise.

Trade Marks.

The following is the Official List of Applications published from July 20 to July 27, for the Registration of Trade Marks, so far as relates to the Metal Trades.

CLASS 5.

CADET
FIREFLY
VICEROY
VOKO
NABOB

The above words have been registered separately, and numbered respectively 164,722; 164,723; 164,724; 164,725; and 164,726, for unwrought and partly wrought metals used in manufactures, by T. Barlow and Brother, 20, Major-street, Manchester; merchants.—11th May, 1892.

CLASS 18.

"*The essential particular of the Trade Mark is the following:—The device, and the applicant disclaims any right to the exclusive use of the added matter.*"

165,205. Lighting and heating apparatus. John McLeownan McMurtrie, 99, Portugal-street, Glasgow, Lanarkshire; brassfounder.—1st June, 1892.

The Official Gazette.

Partnerships Dissolved.

J. D. Aaron and J. S. Stott, under the style of John Aaron, Halifax, engineers, tool and machinery merchants.

J. and W. Whitehead, under the style of Whitehead Brothers, Springfield Ironworks, Farsley, near Leeds, engineers and millwrights.

G. Stanfield, W. Cuthell, and T. Mandle, under the style of G. Stanfield, Cuthell and Co., Maryport, engineers, millwrights, boiler makers, bridge builders, iron and brass founders, and general smiths.

Scotch Sequestration.

Rankin Kennedy, Carntyne Electric Works, Glasgow, electrical engineer, August 9, at 12, Faculty Hall, Glasgow.

THE BANKRUPTCY ACTS, 1883 AND 1890.

Receiving Order.

J. BAXERES-ALZUGARAY (trading as Baxeres and Co.), Broad-street-avenue and Bishopsgate-street Within, City, and Arlington-street, and Prebend-street, Islington, civil engineer and metallurgist.

Adjudication.

T. RAYNER (trading as Scott and Rayner), late Newcastle-on-Tyne, Durham, and Malton, ship and engine repairers, trading in copartnership with G. J. Scott.

Commercial Gazette.

☞ The name given is that of the defendant; the amount is that for which judgment was given, and the date is that on which it was given.

County Court Judgment.

MEREDITH BROS., West Hartlepool, rivet and bolt makers, £22 4s. 8d. 8th July.

New Companies.

ROOTS' PETROLEUM MOTOR SYNDICATE LTD.—This company was registered on the 22nd ult., with a capital of £2000, in £1 shares, to acquire, develop, and turn to account certain letters patent—No. 9311, No. 11,067, and No. 15,882, of 1888; No. 9834, of 1889; No. 19,559, of 1890; and provisional specification No. 9775, of 1891. The number of directors is not to be less than two nor more than five, the first being Messrs. H. Jasper and James D. Roots (the vendor). Registered by Messrs. Williams and Neville, 23, Austin Friars, E.C.

VACUUM CASTING SYNDICATE LIMITED.—This company was registered on the 22nd ult., with a capital of £8000, in £1 shares, to acquire, develop, and turn to account certain patents relating to an improved method of casting metals, glass, etc., to enter into an agreement with Mr. W. S. Simpson, and to carry on the business of manufacturers of and dealers in castings of glass, iron, steel, etc., mechanical engineers, machine and engineering tool makers, boiler makers, etc. The number of directors is not to be less than three nor more than eleven; qualification, 5 shares; remuneration to be fixed by the company in general meeting. Registered by Messrs. Slaughter and May, solicitors, 18, Austin Friars, E.C.

AMERICAN INSULATED WIRE COMPANY LTD.—This company was registered on the 21st ult., with a capital of £75,000, in £5 shares, to acquire, develop, and turn to account certain letters patent, patent rights, etc., relating to the manufacture of wire, wire ropes, and cables for electric purposes, and to carry on the business of manufacturers of and dealers in wire, wire ropes, and cables of all kinds, mechanical and electrical engineers, electricians, founders, machine makers, suppliers of electricity, and manufacturers of electrical apparatus. The number of directors is not to be less than three nor more than seven, the first to be appointed by the signatories; remuneration to be fixed by the company in general meeting. Registered by Mr. T. T. Hull, 22, Chancery-lane, W.C.

Letters to the Editor.

*** *We do not hold ourselves responsible for opinions expressed by correspondents.*

*** *The name and address of the writer (not necessarily for publication) must in all cases accompany letters intended for insertion, or containing queries.*

*** *Letters intended for publication in the current week's issue must reach our Manchester Office not later than by the first post on the Tuesday preceding the date of publication.*

PROVISIONAL PROTECTION OF INVENTIONS.

To the Editor of THE MECHANICAL WORLD.

SIR,—Having had some years' experience in patent matters, I have come to the conclusion that provisional protection, which may have done some good in earlier days, is now dangerous and useless. In fact, the whole of our patent laws want altering and even reconstructing on a new basis. The law which was in force until 1884 was certainly very imperfect, but the present one is worse and more mischievous in its results. Let us by all means abolish provisionals and replace them by certificates of addition obtainable at a low additional fee, as in France, Belgium, or Germany. Renewal fees should be entirely abolished; they are a disgrace to this country, and a State swindle. How many inventors can say to-day that after paying so much money to the Government they possess a valid patent? The United States and German patent laws should be taken as models in future legislation on patents. I am glad to hear that an association is being formed for the purpose of having our patent laws revised in this sense. E. GOBERT.

South Tottenham, July 24.

To the Editor of THE MECHANICAL WORLD.

SIR,—In your issue of the 22nd inst. you make a few valuable remarks on provisional protection of inventions. You say that at times you hear a discontented note by a patent agent or some more than usually intelligent inventor. You put this in proper form, as I think intelligent inventors are scarce. You speak of an earlier protection rendering possible the pirating of a later invention. That is too true; but you don't mention a cure for this. Now, sir, if the patent laws in this country were the same as in America and other countries, there would be no need for provisional protection. I think the British patent laws are a disgraceful imposture on the British workman, and such as no other country would tolerate. JOHN MAGEE.

Belfast, July 23.

To the Editor of THE MECHANICAL WORLD.

SIR,—I am pleased to see in your leader of the 22nd inst., on "Provisional Protection of Inventions," that you call attention to the unsatisfactory state of the patent law, and trust you will continue to show up the weak points till it is altered and patentees get *absolute protection at a reasonable cost.* SPENCER GARDNER.

Adderbury, July 28.

AGRICULTURAL ENGINEERING.

To the Editor of THE MECHANICAL WORLD.

SIR,—In all probability many of your readers who visited the Royal Agricultural Show at Warwick would notice the extensive show of agricultural machinery, and there is no doubt that the successful farmer of the future will require to have a fair knowledge of machinery over and above what we find possessed by the average farmer of to-day.

Although the portable engine has figured very largely in recent shows, it is surprising to find that at the Royal Agricultural Shows of 1839 and 1840 no mention was made of a steam engine. It was at the Liverpool Show of 1841 that the first portable engine was exhibited. The success that has attended the portable engine is due in a great measure to the competitive trials inaugurated by the Royal Agricultural Society, as this class of engine realised a great economy of coal at a very early period. The prize engine of 1849 burned 11¼lb. of coal per horse-power per hour; that of 1850, 7¼lb.; of 1852, 4⅝lb.; of 1853, 4¼lb.; of 1855, 3¾lb.; of 1856, 3½lb.; and of 1872, 2·81b.

It is well known that the application of machinery to agricultural purposes is very old, but very few are aware that the present high state of agricultural engineering dates back to an obscure mechanician, Robert Salmon, who died in 1821. Mr. Salmon may truthfully be called the father of agricultural engineering in England. He was for thirty years (1790 to 1821) surveyor to the Duke of Bedford. It was the Duke's custom to have an exhibition of agricultural implements at the annual "sheep shearing" at Woburn, and award prizes for meritorious novelties, and Mr. Salmon was a constant exhibitor of new inventions at these shows. In 1797 the Society of Arts awarded him 30 guineas for a chaff-cutting engine, the parent of all modern chaff-cutters.

At the Duke's show of 1801 Mr. Salmon exhibited his Bedfordshire drill, which became the model of all succeeding drills. In 1803 he showed a plough wherein the spade was replaced by a skew-wheel, as in Pirie's modern double-furrow plough. In 1804 he brought out an excellent "scuffler" or "cultivator." In 1806 he exhibited a self-raking machine, also a threshing machine; but neither attracted public notice. In 1808 Mr. Salmon exhibited his reaper, and it is a remarkable fact that this early machine embodied all the principles of the modern self-raker, which was not introduced until nearly sixty years later. In 1814 Mr. Salmon patented the first hay-making machine, to which modern improvement has added nothing, except in detail. This ingenious but obscure mechanician died in 1821, comparatively unknown.

Retford, July 25. J. MORGAN.

CONICAL TANK.

To the Editor of THE MECHANICAL WORLD.

SIR,—The solution of conical tank I sent you on the 6th inst., gives it only as far as *whole inches* for the diameters are concerned. As I now find another solution giving decimal parts of an inch, I beg to be allowed to complete my solution, as follows:—K, as stated, = 1147. Ratio of diameters required, 5 to 3. Then $5^2 + 3^2 + (5 \times 3) = 49$, and $\frac{1147}{49} = 23{\cdot}408$; whence $5^2 \times 23{\cdot}408 = 585{\cdot}2$, and $3^2 \times 23{\cdot}408 = 210{\cdot}672$; whence $\sqrt{585{\cdot}2} = 24{\cdot}19''$, and $\sqrt{210{\cdot}672} = 14{\cdot}514''$. Proof: $24{\cdot}19'' \times 14{\cdot}514'' = 351{\cdot}09''$; then $585{\cdot}2 + 210{\cdot}672 + 351{\cdot}09'' = 147 = K$. I think this solution is simpler than the one given in your issue of July 8. WM. COX.

New York, July 21.

OLIVER EVANS AND THE LOCOMOTIVE.

To the Editor of THE MECHANICAL WORLD.

SIR,—If early road locomotives such as those built by O. Evans and Fourness are to be considered as the forerunners of the modern locomotive engine, I think the honour and priority in this matter really belong to Nicolas Joseph Cugnot, whose first engine was built and tried in 1769. The second one, built shortly after, is still in existence, and can be seen at the Conservatoire des Arts et Métiers in Paris. E. GOBERT.

South Tottenham, July 24.

PORTABLE DERRICK CRANES ON HIGH CLIFFS TO RESCUE THE DROWNING.

To the Editor of THE MECHANICAL WORLD.

SIR,—On public grounds I should be grateful if any of your readers could kindly inform me of an approved light, portable derrick crane apparatus so constructed that, at some distance away from the edge of the cliff, a man could be safely lowered in a life-buoy basket down into the sea or seashore. He would thus be protected from the danger of crumbling rocks, stones, earth, and the like falling upon him, and would therefore not require the padded helmet now supplied with the Board of Trade's dangerous and clumsy rope-ladder apparatus.

On many high cliffs such a portable derrick crane is required to rescue the drowning from the waters beneath, so that the rescued can be safely drawn upwards to the cliff above.

Where a man is exhausted by previous exposure or exertion, as in shipwreck, he is usually unable to climb up the cliff rope-ladder, which requires considerable skill and strength.

J. LAURENCE-HAMILTON, M.R.C.S.,
Late Honorary President
Fishermen's Federation.

Brighton, July 26.

SURFACE COOLERS FOR INJECTION WATER.

To the Editor of THE MECHANICAL WORLD.

SIR,—I notice in your issue of the 29th ult. an article on "Surface Coolers for Injection Water." I enclose illustration of an apparatus patented by me some years ago, which dispenses with cooling ponds, and enables engines being made condensing in the very heart of populated towns, and at little or no expense for water; and from the result of the test it will be seen that the apparatus is more than equal to the work of cooling the injection water of a condensing engine. THOS. HILL.

Glasgow, August 1.

Prize Competition.

WE OFFER FOUR GUINEAS MONTHLY IN PRIZES FOR THE BEST ORIGINAL ARTICLES SENT IN ON ANY MECHANICAL, ENGINEERING OR ELECTRICAL SUBJECT.

IN ORDER THAT MANAGERS, DRAUGHTSMEN, FOREMEN, AND WORKMEN WHO HAVE HAD NO PRACTICE IN WRITING MAY NOT HESITATE TO SEND IN COMPETITIONS, IT IS TO BE UNDERSTOOD THAT ALL ARTICLES WILL BE FULLY EDITED AND CORRECTED, AND JUDGED OF SOLELY ON THEIR MERITS AS ORIGINAL CONTRIBUTIONS FROM A PRACTICAL POINT OF VIEW. THE OBJECT OF THE COMPETITION IS TO INDUCE PRACTICAL MEN TO COME FORWARD AND GIVE THE RESULTS OF THEIR EXPERIENCE.

CONDITIONS.

Competitions for our Monthly Prizes must be sent so as to arrive at the Manchester Offices of THE MECHANICAL WORLD, New Bridge-street, not later than the last Tuesday in each month. Articles arriving after that time will be placed in the following month's competition.

Written competitions must be on one side of the paper only. The contributions must be original, and relate to matters connected with Engineering, Mechanism or Electricity.

The Proprietors of THE MECHANICAL WORLD reserve the right to publish any competition, whether it gains a prize or not.

The competitions may be accompanied by diagrams, sketches or drawings.

Competitors should write the words "Prize Competition" on the envelopes.

Competitors are not confined to one, but may send any number of competitions.

The correct name and address of the sender *must* be distinctly written upon every competition, not necessarily for publication. Competitions can appear under a *nom de plume.*

☞ We cannot undertake to be responsible for any MSS. sent to us, though when stamps are enclosed for the purpose we will endeavour to return rejected contributions.

A VERY rich seam of coal has been discovered at Vereeniging, on the Free State side of the Vaal river, and in the immediate neighbourhood of the Cape Transvaal Railway Junction.

Miscellaneous Items.

A line of steam packets from Plymouth to Australia and New Zealand, *viâ* the Cape, is about to be started by the New Zealand and Australasian Steamship Company. The first boat sails on the 30th August, and goes direct to Sydney.

Herr Krupp has decided to send to the Chicago Exhibition a cannon which, if not the largest ever constructed, is certainly an immense piece of ordnance. It will weigh 122 tons by itself, and when mounted on its carriage it is expected the whole will register upwards of 142 tons.

Three years ago the first whaleback was launched. Now there are twenty-five of them in use. Twenty are in the United States inland waters, one on the Pacific, and four on the Atlantic. A shipyard is being prepared on Puget Sound for the building of this class of craft. At West Superior eight are building, six being steamers, and none of them less than 322ft. in length. Two more are to be laid down shortly.

An interesting departure is to be made in the Dundee central station, in the shape of the use of what is known as an air condenser instead of a water condenser. The exhaust steam is led along a series of pipes, the outsides of which are exposed to air, and further kept cool by water trickling down the sides. This arrangement must not be confused with the air cooler often used, in which the hot water is cooled by exposure to the atmosphere after having been condensed by the ordinary water-spray condenser.

A department of naval architecture and marine engineering has been established in connection with Cornell University, one of the chief seats of learning in the United States. Professor W. F. Durand, the principal of the school, has left on a tour to Europe, where he intends visiting the institutions for technical education and the great shipyards, returning in time for the opening of the new college year. The principal is also to be professor of marine engineering, and there is an assistant professor of naval architecture.

The following method has been suggested for coating metal surfaces with glass, which may be found to answer various purposes: Take about 125 parts, by weight, of ordinary flint-glass fragments, 20 parts of carbonate of sodium, and 12 parts of boric acid, and melt. Pour the fused mass out upon some cold surface, as of stone or metal, and pulverise when cool. Make a mixture of this powder with silicate of soda-water glass—solution 60° B. With this coat the metal to be glazed and heat in a muffle or other furnace until it has fused. This coating is said to adhere very firmly to steel or iron.

A magnesium light for light-house and other similar use has been proposed by Professor Schirm, of Berlin, Germany, and experiments with it are said to have been made with the co-operation of the German Navigation Society of Hamburg. From the accounts given it would appear that the light is produced by burning benzene vapour, which, in issuing from a special form of burner, carries with it a certain proportion of finely divided magnesium. A small flame of great intensity is said to be produced. The whole apparatus, however, would seem to be rather complex in arrangement, so that its practical value, for the present, would appear to be in some doubt.

The Board of Trade has just issued an order, which will come into force on October 1 next, reducing the renewal and other patent fees for inventions as follows:—Before the expiration of the 4th year, £5, instead of £10; 5th year, £6, instead of £10; 6th year, £7, instead of £10; 7th year, £8, instead of £10; 8th year, £9, instead of £15; 9th year, £10, instead of £15; 10th year, £11, instead of £20; 11th year, £12, instead of £20; 12th year, £13, instead of £20; 13th year, £14, instead of £20. On enlargement of time for payment of renewal fees:—Not exceeding one month, £1, instead of £3; not exceeding two months, £3, instead of £7; not exceeding three months, £5, instead of £10.

Many propositions have been made for the utilisation of the heat of slag in raising steam, but nothing practicable has hitherto been attained. News, however, comes from Australia that the owners of the Broken Hill Proprietary Mine, Broken Hill, New South Wales, have built a plant invented for that purpose by Messrs. Howell and Ashcroft. The molten slag is run into the bottoms of iron chambers, capable of withstanding internal steam pressure, and jets of water are then forced in on the surface of the slag. The water becomes vaporised, and in a short time the chambers become filled with steam of a certain pressure. It is said that the process has given satisfaction, but no exact data are to be obtained.

The royal Hungarian railroad commissioners have just issued a pamphlet, with detailed, tabulated figures, designed to show the results which have been reached by the adoption of the zone tariff. The benefits of this tariff, according to the report in question, are to be looked for, not alone in the financial returns, but fully as much in the development and growth of general traffic. In this respect, it would appear the zone tariff has fully satisfied all expectations which were entertained of it. As to the financial outcome, it is stated that for the year 1890 there was, under the working of the zone tariff, an

appreciable increase in the total expenditures, but that this was more than counterbalanced by the larger receipts due to the greater number of passengers carried. It is claimed that 54 per cent. of the net receipts is directly attributable to the new form of tariff, so that it will be seen the latter might be saddled with quite a lot of additional expenses before the balance in its favour would be wiped out.

The publisher of "The Mechanical World" will send a prepaid parcel of specimen copies to anyone, in any part of the world, who can distribute them advantageously amongst his engineering friends. Business card or bill-head should be enclosed as a guarantee of good faith, and number of copies stated.—Address: 391, Strand, London, or New Bridge-street, Strangeways, Manchester.

Queries.

☞ Readers are invited to avail themselves of this section for practical information on questions relating to Mechanical Engineering and the Scientific Industries.

☞ Queries and Replies should arrive at the Manchester Office not later than by the first post on the Tuesday preceding the date of publication.

MAKERS OF CELLULOID.—Required the names and addresses of extensive makers of celluloid.—B. P.

NICKEL.—In an alloy of cast iron and nickel what is the increase in strength over cast iron, and what proportion of nickel should be used?—T. C.

ECONOMISER SCRAPERS.—What means must I adopt to renew some broken scrapers in the middle of the range of pipes in the economisers?—PUZZLED.

PATTERNMAKER'S TOOL BOX.—Will any reader give me a sketch of the patternmaker's tool box, with full dimensions and particulars?—APPRENTICE.

CRUCIBLE.—Will any reader inform me how plumbago crucibles are made for melting brass and steel; also sketch of machine for making same?—PLUMB.

MAKERS OF COMPRESSED PAPER.—Will any reader inform me of the address of a maker of compressed paper, such as used for carriage wheels and the like?—T. D.

RIFLING MACHINE.—I should be glad of a sketch of any appliance used for rifling out small barrels, such as revolvers, etc., say ¼in. to ⅝in. bore, with threads, say, 6in. pitch.—NEMO.

WOVEN BELTING.—Can anyone give me the recipe for or supply me with the proper paint for cotton belting? I can weave it right enough, but cannot get a satisfactory paint.—BARCELONA.

HOT-AIR ENGINE.—Will some reader of THE MECHANICAL WORLD kindly oblige me with a section and principal dimensions of a ½H.P. single-acting hot-air engine of the Stirling cycle?—GEO. H. PERKINS, North Queensland.

ROLLER-BORING TACKLE.—Will some reader favour me with a sketch of a tool for boring hard wood rollers of various kinds in the lathe from 1ft. to 3ft. in diameter, and from 3ft. to 5ft. long? The holes are to pass right through, and to be from 1in. to 3in. diameter.—BORE.

LOSSES IN STEEL FURNACES.—Could any reader kindly inform me the average per cent. of actual loss, and the average per cent. of skull, in the charge of a Siemens open-hearth steel furnace working charges of from 30 to 40 tons? And also the per cent. of loss in heating slabs and ingots in the Siemens regenerative gas furnace?—J. R. R.

HEAD-GEAR FOR COLLIERY.—I have contracted to make a pitch-pine head-gear for a colliery. The pitch pine is 16in. square, and the head-gear is to be 35ft. high; also, it has to be placed on either brick or stone pillars 15ft. high. Can anyone inform me of a good plan to get it to the top of these pillars, or will someone kindly show me how I am to get it into position?—ALPHA.

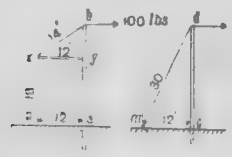
WATER FLOWING INTO JET CONDENSER.—Will some fellow-reader kindly give me a worked-out example of the quantity of water that will flow through a 4in. pipe 30ft. long, with four bends, into a jet condenser with 18in., 24in., and 28in. of vacuum; wheel valve wide open, giving same area as pipe; also with it half open? The water supply tank is 8ft. below condenser. The condenseris working on a set of triple-expansion engines. What effect have bends and temperature on supply water?—SUGAR MILL, North Queensland.

LOCOMOTIVE CONSTRUCTION.—Will any correspondent enlighten me as to the mode adopted in locomotive work in order to fix the position of the axles (horizontally) so that each axle may have a predetermined portion of the total weight resting upon it? Say:—

Load on leading axle	0·32
„ driving „	0·48
„ trailing „	0·20
	1·00

Of course, I am aware there are certain circumstances—such as length of barrel, position of firebox, etc.—which in practice to a great extent influence this, but the point I wish clearing up is: Given the total weight, how are the positions of axles determined so that the pre-arranged weights rest on them? An answer would be of service to others as well as to—HILLSLAND.

STAYING TELEGRAPH POSTS.—*a b* and *c d* are two telegraph posts of equal height, firmly fixed into the ground. How can *m d* be



proved to be a stronger way of staying than *n x b*? Also, what is the compressing thruston the strut *x y*, and the bending moment about *y*?—TELEGRAPH POST.

Replies.

☞ Owing to the constant increase in our correspondence we regret that we have no alternative but to announce that we cannot reply by post to Queries even when stamped envelopes are sent.

☞ Queries and Replies must in all cases be accompanied by the names and addresses of the writers, as no notice will be taken of anonymous communications.

J. H.—No address is given in your letter.

J. MARSHALL.—Apply to Messrs. Austin and Myers, Armley, near Leeds.

NOVICE.—Perhaps you have burnt the steel in annealing it, causing a hard scale to form upon the surface.

TOM TOUGH.—We think Messrs. Hall and Pickles, 64, Port-street, Manchester, will be able to supply you.

T. C.—We believe Messrs. Selig, Sonnenthal and Co., 85, Queen Victoria-street, London, E.C., supply the dies named.

BARCELONA.—Staub's "Textile Ready Reckoner," and Nasmith's "Student's Cotton Spinning," 6s. Both works may be had from our office.

AUTOMATIC.—Mr. James Proctor, Burnley, is a maker of an excellent mechanical stoker, which would doubtless suit your requirements.

C.—Von Ott's "Graphic Statics," 5s, and Charnock's "Exercises in Graphic Statics," 4s. 6d., may suit you. Both may be had from our office.

X. Y.—(1.) Yes. (2) We would advise you to apply to Messrs. Richard Frères, 43, London-wall, London, who will doubtless be able to supply such an instrument.

MECHANIC.—You will be able to obtain full particulars by applying to the Assistant-Secretary, Marine Department, Board of Trade, Whitehall, London.

SHELTON.—We do not know of any work on gas engine testing. There are some particulars of tests given in Prof. Thurston's "Handbook of Steam Engine and Boiler Trials," the price of which is, we believe, 18s.

SWANSEA.—There are quite a number of blowers in the market, each of which claims to be an improvement upon the Roots, so without more particulars we are unable to assist you.

BORE.—Engineering Patternmaking appeared in our issues for Oct. 18, Nov. 1 and 22, Dec. 6 and 27, 1890; Jan. 17, Feb. 14, March 14, April 11, May 2 and 30, June 13, July 18, Aug. 21, Sept. 11, Nov. 27, Dec. 25, 1891; Jan. 29, Feb. 26, April 15, May 27, 1892.

R. J. HICKTON.—If your 4in. plunger is weighted with 30lb., the pressure per square inch exerted on the water is

$$\frac{30}{4\times4\times0{\cdot}7854}=2{\cdot}39\text{lb.}$$

The pressure on the 1in. outlet will consequently be $0{\cdot}7854\times2{\cdot}39=1{\cdot}91$lb., or $\frac{1}{16}$, and not ¼, the pressure on the plunger. While you maintain the same relative areas you cannot alter the proportion of pressure exerted on each.

ALUMINIUM.—Will any reader inform me what is the greatest percentage of metal alumina has been found to contain up to the present date?—ALUMINA.——*A.*—The greatest percentage in the North of England is 23 to 45. I am open to correspond.—ALUMINIUM.

FRICTION OF WATER IN PIPES.—What is the head of water in feet necessary to overcome the friction of a bend 10in. bore and 12in. radius; velocity of water, 170ft. per minute?—VULCAN.——*A.*—A rule for the head due to the change of direction is

$$H=\left\{0\,131+\left(1{\cdot}847\times\left(\frac{r}{R}\right)^{\frac{7}{2}}\right)\right\}\times\frac{V^2\times\phi}{960}$$

in which H = head in inches required to overcome the resistance of the bend; r = radius of bore of pipe in inches; R = radius of the centre line of bend in inches; ϕ = angle of bend in degrees; V = velocity of discharge in feet per second. From this "Vulcan" can obtain the head of water required to overcome the resistance of the bend.

COLLIERY HAULAGE PLANT.—I should be very pleased if some reader would give me some information on the following subject. In laying down a plant for endless rope haulage at a colliery the following data are given:—The engines are fixed at the pit bank, at a distance of 20yds. from the shaft. The shaft is 200yds. deep. Ropes are carried down shaft in wooden boxes. Said ropes are 1¼in. round steel. From the pit bottom the haulage extends a distance of 3000yds. Starting at the end farthest from the pit bottom, the road rises 1 in 20 for 300yds., then 1 in 14 for the next 200yds., then it is level for 100yds., then a fall towards the bottom of 1 in 30 for 200yds., then a rise of 1 in 5 for 300yds., and the remaining 1900yds. has a rise of 1 in 21. The speed of the rope is 1½ miles per hour. The weight of the corves is (empty) 4cwt., and each corf contains 8cwt. These are hung on the ropes in pairs at a uniform distance of 10yds. apart. The empty corves are hung in the same way. The driving pulley on engine to be about 6ft. diameter. The boiler pressure is 50lb. The rope runs over the corves, and in the 3000yds. each rope has 10 holding up pulleys. What I should like to know is how to calculate the H.P. required to run the haulage; also how to calculate the size of engines and gearing to develop a H.P. having sufficient margin for same; also what margin is necessary? In this arrangement the road is pretty straight. What difference would it make to the power required, supposing there is a curve in the roads containing an angle of 135°?—NOVICE.——*A.*—In my answer to this query I notice that the fall of 1 in 30 for 200yds. is given as a fall of 2000ft.; this ought to have been given as a fall of 20ft. I gave the cylinders at 18in. diameter; but after reconsidering, I would advise nothing less than 21½in. diameter for two cylinders. The reason for the larger size is that it would be difficult to start with 18in. cylinders when one crank is on a dead centre. With 21½in. cylinders there would be an overplus for starting with. The power to overcome the friction was calculated for edge rails. Is "Novice" sure he has given all weights attached to the rope?—ENGINE DRIVER.

Latest Inventions.

APPLICATIONS FOR LETTERS PATENT.

When Patents have been "communicated," the name of the communicating party is printed in italics.

Where complete specification accompanies application, an asterisk is suffixed.

18th July, 1892.

13,111 LINK MOVEMENT for LOCOMOTIVES.* S L Branton.

13,117 GAS or PETROLEUM HAMMERS, GAS PUMPS, etc., in PART APPLICABLE to GAS or PETROLEUM ENGINES. D Clerk.

13,121 TREATING RESIDUES from ZINC SMELTING, GALVANISED IRON SCRAP, etc. E H Cook and A E Petter.

13,122 CONTROLLING the TRAFFIC on SINGLE-LINE RAILWAYS. F W Webb and A M Thompson.

13,123 MECHANICAL ARRANGEMENTS for LOADING TRUCKS with HAND-PLACED COAL. W Hay, jun.

13,125 SELF-DRIVING MOTOR. A Blattner.

13,127 SELF-LOCKING NUT for STEAM ENGINES, etc. J H Rowland.

13,129 GRIP APPLIANCE for AUTOMATICALLY ARRESTING the MOTION of LIFT or ELEVATOR CAGES.* J Stevens.

13,131 ROAD PICKING MACHINES. A H Wallis.

13,134 VOLTMETER. F H Nalder and others.

13,137 PRODUCTION of STEEL and the MANUFACTURE of SPRINGS THEREFROM. L J D Holtzer.

13,138 COUPLINGS for RAILWAY CARRIAGES. F Parkinson.

13,146 MICROPHONES. Sir C S Forbes, Bart.

13,148 HARDENING PARTICLES of STEEL.* G G M Hardingham. (*Hugo Wilisch*, Germany.)

13,150 VALVES. E J Preston and F G S Ham.

19th July, 1892.

13,155 SHIP or BOAT PROPELLER. A Clifford.

13,160 INCREASING the EFFICIENCY of TELEPHONIC COMMUNICATION. T Oddy.

13,164 JOURNAL BEARINGS.* F V Benthuysen.

13,165 DIVIDERS.* W A Bernard.

13,166 PLIERS and CUTTERS.* W A Bernard.

13,167 ELECTRIC ARC LAMP.* W E Irish.

13,184 DREDGERS. P Ferguson and W Y Fleming.

13,185 WATER-TUBE BOILERS. J Andrews.

13,187 DRIVING MACHINES for BOTTLING and SYRUPING ARTIFICIAL MINERAL BEVERAGES. C Samson and others.

13,192 STEAM GENERATORS.* E A Magee.

13,194 ANNEALING FURNACES. E G Brewer. (*A A Cowles*, United States.)

13,202 MECHANISM for REPRODUCING SOUND VIBRATIONS RECORDED by the GRAMOPHONE. A Flürscheim.

13,204 GAS and OIL MOTOR ENGINES. C D Abel. (*The Gas Motoren Fabrik Deutz*, Germany.)

13,205 SHUT-OFF VALVES. W A G Schonheyder.

13,207 INCANDESCENT ELECTRIC LAMPS. L Stirn.

13,218 INSULATING SUBMARINE CABLES and UNDERGROUND INSTALLATIONS. T S Lemon.

13,221 TELEPHONES.* W Deckert.

13,223 AXLE LUBRICATOR.* J S Patten and M Schaeffer.

13,228 WATER METERS. W P Thompson. (*L Valentin*, Germany.)

13,230 AUTOMATICALLY OPENING and CLOSING VALVES of PUMPS. J G W Hartman.

13,235 HYDRAULIC MOTORS.* S S Marsh.

13,242 APPARATUS for the DESICCATION of SOLID MATTERS.* E Donard and G Boulet, jun.

13,247 ENGINES. H T Hamilton.

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13,249 FOSTER'S PATENT GRIP PULLEY. A J Foster.

13,266 VALVES. W Cooper.

13,279 APPARATUS for AERIAL NAVIGATION. L A Boisset.

13,281 MANUFACTURE of BARBED WIRE. J S Reid.

13,288 CONNECTIONS for ELECTROLIERS. H Hirst.

13,298 APPARATUS for EFFECTING the CASTING of METALS in VACUO.* W S Simpson.

13,299 ROTARY CUTTING TOOLS.* J R Haustein.

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13,308 DUPLEX SELF-ACTING RAILWAY SIGNALLING SYSTEM. J E Webb.

13,310 PORTABLE MACHINE DRIVEN by MEANS of STEAM or COMPRESSED AIR. W G Potter.

13,321 CONSUMING SMOKE. R Greenhalgh.

13,323 PRODUCTION of ELECTRIC ENERGY. H C Bull and G B Cowl.

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13,335 SIGNALLING by ELECTRICITY on RAILWAYS. T Whittingham.

13,339 APPARATUS for the PRODUCTION of FUEL GAS.* J M Bailey.

13,356 SCREW STEAMSHIPS. E F Wailes.

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13,359 CREATING or INCREASING DRAUGHT in BOILER and OTHER FURNACES. E Wardle and J H Evers.

13,363 GAS REGULATORS. L Gardner.

13,375 ELECTRIC METERS and RECORDING APPARATUS. W L Spence.

13,377 MACHINE for CUTTING PAPER. B J B Mills. (*J G Pavyer*, United States.)

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13,381 ELECTRICAL STORAGE PLATES, CELLS, or ACCUMULATORS. E B Bright and L W Mercier.

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13,395 ELECTRICAL APPARATUS for SIGNALLING. M Mercier.

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13,105 PORTABLE LECLANCHÉ BATTERIES. H Nehmer.

13,409 MOTIVE POWER ENGINE. L A Boisset.

13,410 MOTIVE POWER ENGINES. L A Boisset.

13,413 SEPARATING PULVERISED ORES and GOLD BEARING SANDS by COMPRESSED AIR.* G Henoch and E M C Exelmans.

13,415 TRANSMITTING SIGNALS to or FROM SHIPS at SEA. A R Sennett.

13,418 JOURNAL BEARINGS.* A E Smith.

13,422 MOTOR SPRING. A J Boult. (*H Kaufmann*, Germany.)

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13,436 CASTING MOULD for BRASS and IRON. W Redfern.

13,437 DUPLO-TUBULAR BOILER. J Brewerton and J H Maybury.

13,438 FUEL ECONOMISERS. E Topham.

13,441 MILLING CUTTERS for METALS. J McAdam.

13,453 ELECTRODES for USE in ELECTROLYTIC APPARATUS. G Bamberg.

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13,467 APPARATUS for DISCHARGING GAS RETORTS. B and W P Gibbons.

13,470 PREVENTION of CHOKED ASCENSION PIPES in the MANUFACTURE of COAL GAS. T B Jones.

13,471 WATER MOTORS. F H Sohn.

13,481 CONSUMING SMOKE in STEAM BOILER FURNACES. J Saddler.

13,484 DRIVING BELTS and ROPES. C A Pallin.

13,491 STEAM JOINTS for ROTARY PIPES and HOLLOW SHAFTING.* J B Morgan and H Adams.

13,492 ADDING MACHINES. H H Lake. (*S L Huizer*, Holland.)

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FRIDAY, AUGUST 12TH, 1892.

Metallic Sleepers.

LENGTHENED experience under ordinary working conditions tends to show very conclusively that the advantages claimed for metallic over wooden sleepers are more imaginary than real, and on many railroads their use is now being discontinued. An interesting summary of five years' experience with metallic sleepers on the Belgian State Railways is given in a French contemporary. In this case two patterns of metallic sleepers are used, both of the same weight, 165lb., but of somewhat different cross-section. The flange-rails, weighing 76·6lb. per yard, are fastened to the sleepers by movable clips and bolts and nuts. There are 12 sleepers to a metre rail. Careful observations were made on four sections of track with half-ing creosoted oak sleepers. It was found very difficult to keep the metallic sleeper track in good shape, particularly as the stone ballast was ultimately pulverised by the sleepers, necessitating the addition of new ballast last year. The metallic sleepers are themselves in damaged condition, owing to cracks which start at the bolt-holes. Of 240 sleepers of each pattern which were carefully examined, 77·5 per cent. of the Braet form were more or less cracked, and 17·9 per cent. of the Post type were similarly damaged. Up to the time of making this report the track with metallic sleepers has cost for maintenance about nineteen times as much as the track with creosoted oak sleepers. But beyond this, many of the metallic sleepers are damaged to such an extent that they must soon be removed. In this connection it may be of interest to note that after fifteen years' experimenting the Pennsylvania Railroad Company have decided to discontinue the use of steel sleepers, as they are found to be too light, and they cannot be kept in line or made to grip the ballast firmly.

The City and South London Railway.

IT is satisfactory to note that the City and South London Electric Railway is now commencing to show commercial results. The line has been in operation for nearly a year and three quarters, and the shareholders in the company, who met on Friday last at the sixteenth half-yearly ordinary meeting, must have congratulated themselves that the railway has commenced to turn the tide. The number of passengers carried, according to the statement of the chairman, had increased from 2,412,000 in the first half of 1891, to 2,813,000 in the first six months of this year. This is, however, exclusive of 100,000 season tickets, a number which, on such a short line, is remarkable. After providing for debenture interest and the full dividend of 5 per cent. per annum on the perpetual preference shares, a dividend of ½ per cent. is to be paid on the ordinary shares, leaving a balance of nearly £1000 to be carried forward to the next account. It is noteworthy that the expenses are gradually being reduced, being 70 per cent. this year as compared with 79 per cent. in the corresponding half of last year. The running expenses have diminished, being now 7·7d. per train mile, as against from 9d. to 10½d. per train mile on steam railways. Altogether this pioneer line is making good progress, and will enhance the prospects of the other similar lines already projected.

The Boilers of Warships.

ON many occasions, especially when giving the results of full-speed trials of warships, we have had to chronicle failures of boilers by leakage at the tube-plate, which in actual warfare would have been simply disastrous. Many experiments have been made both by British and foreign naval authorities, but until quite recently the evil had not been overcome. H.M.S. "Thunderer," which had been re-engined and furnished with new boilers, proved one of the worst cases. So troublesome were her tubes that she had to be sent home from the Mediterranean, and it was almost decided to take her new boilers out and to replace them with others of another type. But before proceeding to this extremity some experiments were made with a new supplementary tube ferrule which had given promise of overcoming the evil referred to. In order to thoroughly test its efficacy the vessel was sent for a voyage to Madeira and back at high speed. This test is certainly a sufficiently severe one, for as modern battleships go, a voyage to Madeira at full speed is, owing to their limited coal capacity, about as far as they can travel. The "Thunderer" has passed the ordeal successfully, and we find her restored, after a comparatively brief disablement, to the ranks of vessels which can be relied on in case of need. It would appear that one of the most serious difficulties connected with the boilers of our warships has at length been overcome, and if this is so, the Admiralty certainly deserve to be congratulated.

The Production of Caustic Soda and Chlorine Gas.

SOME time ago we referred to an electrical process for the manufacture of caustic soda and chlorine from common salt, due to Mr. Greenhill, and which was about to be worked by a limited company. We now learn that a new process is being introduced by the Electrolytic Caustic Soda and Chlorine Co., who have erected works at Snodland. The plant comprises a boiler which supplies steam to a condensing beam engine, which drives a Gülcher dynamo. A tank placed in the upper part of the building contains the salt which is dissolved in water, solution being facilitated by means of an agitator. From here the solution descends by gravitation to the decomposing tanks, of which there are twelve at present. These tanks are 20ft. long, 3ft. wide, and 9in. in depth, and are made of slate. They are arranged in series, and each tank is divided into sixty compartments; the dynamo gives current at 44 volts, and each tank therefore requires about 4 volts. The chlorine gas is evolved at the positive electrode, and is led away by a pipe to the chlorine chambers, the withdrawal being assisted by a small steam jet. The caustic soda, which is formed at the negative electrode, dissolves in the water and sinks, when it is drawn off into a tank, from which it is pumped into the concentrating pans. It is here boiled, and upon cooling it solidifies. The chlorine gas, as already mentioned, passes from the decomposing tank into the gas chamber. A hole is arranged in the floor, by which the bleaching powder is emptied below into casks. There are two of these chambers, the gas passing from one to the other. In addition there are two tanks fitted with agitators and filled with lime solution. These tanks serve the purpose of taking up any escaping or excess chlorine gas for producing bleaching liquor. The present plant, it is said, can turn out from 10 to 20 tons per week, and hopes are entertained of the process effecting considerable economy over the present means of making caustic soda and bleaching powder or liquor.

Scotch Shipbuilding Returns.

THE shipping launched from Scotch shipbuilding yards during last month was of an unusually large amount, notwithstanding the fact that the annual holidays took place during that period. Unfortunately the orders for new vessels have not been sufficient to counterbalance the tonnage which has left the yards. Still the quantity of work in hand is considerable, although it is much less than that on the books a year ago, and in view of the present condition of the freight market there is not much prospect of improvement except from lower prices. The month's record of launches is exceptionally increased by the inclusion of the tonnage of two large new steamers constructed for the Peninsular and Oriental Steam Navigation Company. Scotch shipbuilders launched 30 vessels, of 36,754 tons, of which 22, representing 22,554 tons, were steamers, and 8, measuring 14,200 tons, sailing vessels. To the total the Clyde contributed 21 steamers of 22,134 tons, and 7 sailing vessels of 13,900 tons; the Dee, a steamer of 420 tons; and the Forth, a barquentine of 300 tons. The production of last July was 16,638 tons. To the total, yards above Govan contributed 29 tons; Govan, 1330 tons; Partick, Whiteinch, and Scotstoun, 5000 tons; Renfrew, 580 tons; Paisley, 1080 tons; Yoker and Bowling, 450 tons; Dumbarton, 5800 tons; Greenock and Port-Glasgow, 20,800 tons; Irvine, 400 tons; and Ayr, 565 tons.

Engineering Problems.

THE system adopted by the Société Industrielle de Mulhouse of offering prizes for the best solution of problems connected with steam engineering, has, we are of opinion, much to recommend it, and we are quite at a loss to understand why our engineering societies cannot follow this excellent example. Among the prizes offered by the Alsatian institution is one of a silver medal and 500fr. for a means of determining the quantity of priming water in the steam supplied to a steam engine. We need hardly say that this is a problem which has much exercised engineers who are engaged in engine testing, as none of the methods hitherto adopted can be considered satisfactory. Another medal is offered for an integrating dynamometer which shall be capable of showing by means of an autographic record the rate at which work has been done at any particular time. A prize of 500fr. and a medal is also offered for an experimental research into the proportions of factory chimneys. A similar prize is offered for researches into the motion and condensation of steam in long pipes, the points to be established being the loss of pressure as dependent upon the length of the pipe, and the condensation to be expected with different varieties of lagging. In addition to the above medals, others are offered for an autographic pyrometer capable of recording, within an error of not more than 5 per cent., the temperatures of the furnace gases of an ordinary steam boiler; for improvements of the gas engine effecting a notable economy in the gas used; and for a method of heating boilers by first turning solid fuel into gas, and using the latter under the boiler, by which an economy of 10 per cent. shall be effected on the methods now employed in Alsace. We understand that further information as to these awards can be obtained from the secretary, M. H. Walther-Meunier.

Paper-bag Making Machinery.

MUCH ingenuity has been expended upon machines for making paper bags, envelopes, etc., but a bag-making machine which turns out 40 finished paper bags per minute must, we think, certainly represent a marked advance so far as the rate of production is concerned. Such a machine is described in an American contemporary as consisting of a wheel about 2½ft. diameter, having attached to its tyre at regular intervals 40 square-shaped hollow spokes made of zinc and brass, each being perforated at the top and near the joint with holes for the admission of air. The paper to be used in making the bag is first cut to the size required, and then fed into the machine in a way similar to that required for small printing presses. In the centre plate on which the paper first rests is a wide slot through which each spoke passes in turn, carrying down with it the paper, which thus receives its first fold. As it disappears, paste boxes on either side of it and at the bottom furnish the needed paste at the proper places, and another clever piece of mechanism gives the final folds. As the revolution continues the points of the newly-pasted bag, which are yet damp, pass along a steel band heated by drying boxes attached to it. These boxes are heated by gas. By the time each spoke completes its revolution the paste is perfectly dry, and a rubber device on either side of the spoke automatically throws the finished bag to a conveyor. The whole machine weighs about 1800lb. The operator has only to press his foot on a treadle to start the machine, and to remove the foot to stop it.

Gas Engines for Dynamo Driving.

THE German Imperial Continental Gas Association, Dessau, after running dynamos by means of gas motors for five years, tabulates the advantages of the system as follows:—1. Small amount of space required. 2. Small consumption of water; 5 to 6gals. per horse or less. 3. No coal to carry; independent of railway station. 4. No smoke. 5. No explosions. 6. Cheaper than steam engines in respect of (1) ground required; (2) relative convenience of gas motors rather than steam engines in a town, whence greater choice of place within a town, and smaller distances to lay cables; (3) gas motors above 100H.P. being cheaper than steam engines, boilers, chimneys, etc. 7. Less loss of electricity, because station more favourably situated. 8. Less attendance and wages. 9. Exact control over fuel. 10. More regular working and greater security of power to meet unforeseen demands. 11. Cost of fuel can be reckoned (the gas company running the electric station) at the full cost price of the gas supply.

ACCORDING to a recent decision of the French courts, an invention for which a patent has been demanded in Germany cannot be patented in France if the claims made in the patent have been published in the Official Journal of the Empire, in conformity with Articles 22 and 23 of the Law of May 5, 1877.

Engineering Pattern Making.

By A Foreman.

XXII.

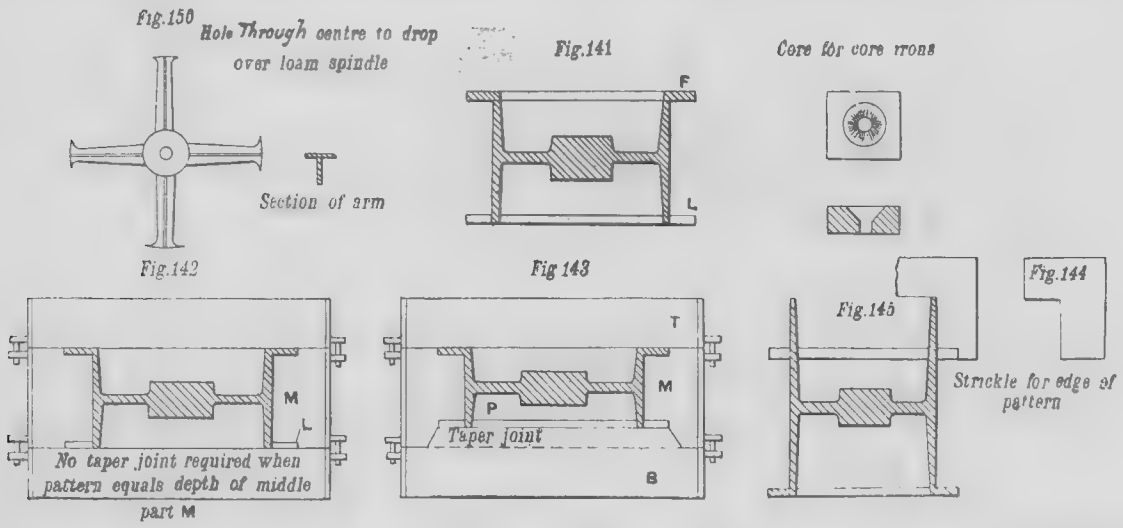
Having given the principal methods of rope-pulley making, we shall now proceed to the consideration of belt pulleys, giving the methods whereby the patterns are prepared for splitting or casting in halves, and to provide for the increasing or diminishing of the width of face, known as "rising" or "stopping off."

Pulley patterns up to 24in. diameter are best made by building the rim up with segments cut from sound and dry timber, and good joints for this portion of the patterns are absolutely required, there being no width to admit of the insertion of wooden pegs for securing the several layers of segments, the first of which should be put on the faceplate with a little thin glue and a few fine screws. As this layer will form the base upon which to build up the several thicknesses forming the whole width of the pulley rim, allowance should be made to turn this first layer off when the pattern is finished.

When the building up has reached the half width the inside should be turned out to the finished size, preparatory to letting in the arms, which should be completely finished with the exception of the ends fitting into the rim, and forming the hollow or finish of the arms with the same. Pulley arms of any form may be put together as previously described, securing the joints at the centre by tonguing with hard wood. If possible, the joints of the segments should be so arranged that the thickness of the arm may equal the thickness of the segment into which it is recessed, thus avoiding any paring between the arms, as the inside of the rim can be turned on every layer. The following rows of segments must be then glued on until the full depth of the rim is obtained.

In the larger pulleys it is usual to strike up the rim in loam, and to turn the casting inside and out to form a pattern. In this case it is usual to have loose sets of arms, which admit of any width of casting being made, the distance from the top of the rim being set by a gauge, or measured by the moulder when the casting is required narrower than the pattern.

The majority of wooden patterns of S and C-armed pulleys, though constructed as strongly as possible, yield in a short time to the effects of the damp sand and the loosening of the joints occasioned by the "rapping," and though a wooden pattern is considerably lighter to handle, and much more easily manipulated, a metal pattern is necessary when quantities are required. Belt pulleys running at a high speed, in addition to the convexity given to the face, are frequently provided with flanges on one or both sides. In the first instance, with a single flange, the moulding of the pattern is not interfered with, as it merely forms an increased diameter, which is level with the top of an ordinary two-part moulding box; but when a flange is required on both sides of the pulley it necessitates the use of a three-part moulding box, the flange on the bottom side of the pattern being left loose. This allows the pulley to be moulded as follows:—The pattern, Fig. 141, is placed on a false bottom part, rammed up, or on a level board, with the fast flange F downwards. The middle part M of the moulding box, Fig. 142, is then placed over it, and rammed up with facing and black sand until the underside of the loose flange L is reached; this is then slipped over the pulley, and the box is further rammed up to the level of the overall depth of the pattern, and from which line a taper joint is made to the edge of the box as shown in Fig. 143. This being sprinkled with parting sand is ready for the bottom part B, which is rammed up and strickled off with a straightedge. A few handfuls of black sand are thrown over the level bottom to form a soft bed, a turning-over board is bedded on the top, and the bottom and middle parts together are turned over, leaving the false part and exposing the top side of the middle part, which is then similarly treated with parting sand, and is then ready to have the top part T put on and rammed up. A taper piece of timber forming the "git" is usually set on the boss of the pulley. The ramming up of the top part being completed, it is lifted off the middle part, and the pattern then drawn, leaving the loose flange in the mould between M and B. The middle part is next lifted, and the flange taken over the projecting sand P forming the core or inside of the pattern, and after dusting the mould with plumbago or blacking, and smoothing over, the parts are then put together and made ready for casting. The advantage of a loose flange fitting over the outside diameter of the pattern is, that any width of pulley may be made from the same pattern, the flange being set to the required distance by means of a strickle (Fig. 144) used on the edge of the pattern as shown in Fig. 145, and it is in this particular case, where the width of the pulley over the flanges is less than the depth of the middle part of the moulding box, that the taper or inclined joint is necessary, as this allows of the recess formed in the bottom part B by the projecting portion of the pulley rim being filled up or "stopped off."



Cone or speed pulleys require a slightly different arrangement, though the construction of the one at Fig. 146 is precisely the same as the one in the preceding pattern, but with a series of segments of increasing diameter, the smallest speed being set against the lathe faceplate.

In moulding this class of pulley it is sometimes necessary to form the inside by means of dry sand cores made out of the pattern, and set in the bottom or bolted to the top of the mould. The reason for this will be seen by reference to Figs. 147, 148, and 149, the first of which consists of four speeds, equally divided on a plate which carries the bosses forming the bearing on the shaft. In Fig. 148 the plate is fixed in the pulley on a line with the edge of the third speed, and in Fig. 149 the bearings are at each end, and consist of a plate and boss in the smallest speed and three or four arms (Fig. 150) in the largest.

Any of these may be arranged in the speed-pulley pattern, which should be made without a centre plate, the open pattern being preferable, as it allows of the different bosses, arms, and plates being set where required. In Fig. 147 the position of the plate will not admit the whole of the pulley being made in green sand, consequently a dry-sand core is made out of the lower part, and level with the underside of the plate carrying the bosses.

The pattern is then inverted on a level false top or board, and a sufficiently deep bottom-part moulding box is placed over it; the pattern is then rammed up and the box and pattern turned over together, and still leaving the top part to be rammed up, which must be well "gaggered" to carry the sand forming the green-sand core. This being finished, it is lifted off, and the dry-sand core is set in the bottom of the mould and a couple of long spikes pushed through to prevent it from "lifting" or being disturbed; the core is also blackened before being set in the mould, and the holes into which the spike heads are sunk are made up with a little loam. In this case, as also in Fig. 148, the top core is made in green sand. This, however, is quite optional, as frequently both the inside ends are formed with cores, and certainly a better casting is obtained by adopting this method; but when the casting is urgently wanted it often happens that there is no time to dry the cores so that they could be used with safety. In Fig. 148 the entire mould could be formed in green sand, as the position of the plate is unlike that at Fig. 147, there being the one projecting piece of sand passing through the first speed only.

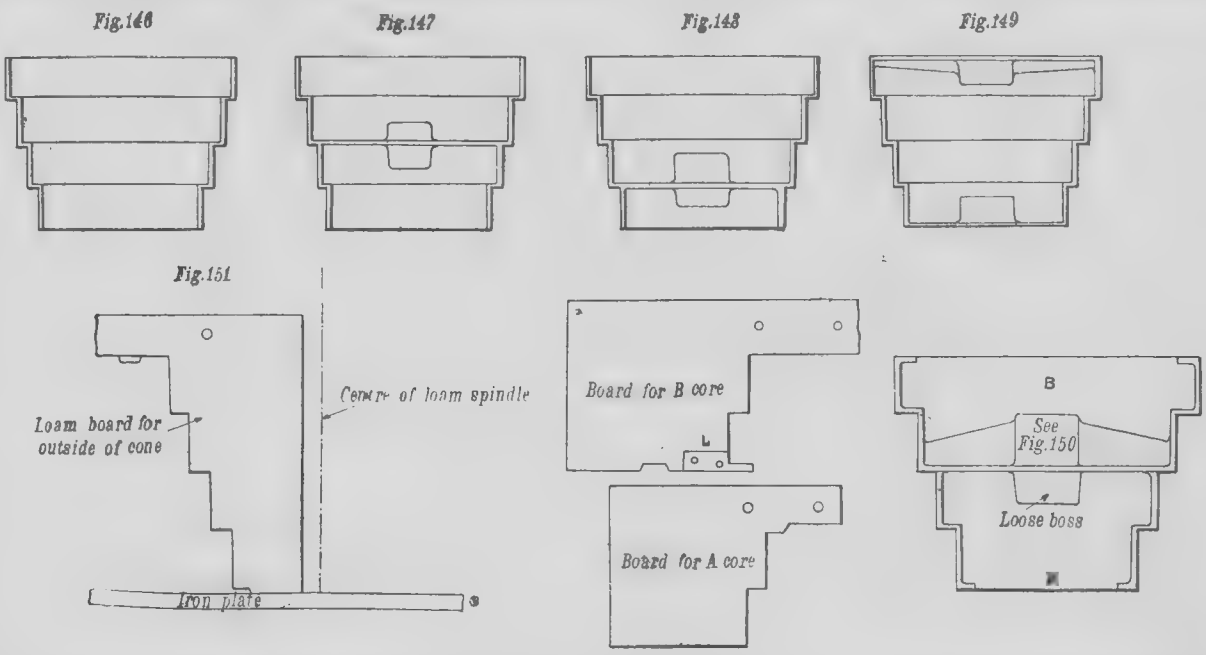


Fig. 149 presents a case in which the entire inside is formed with a core made out of the pattern. A plate or ring (Fig. 150) is rammed up in the core, which is then bolted up to the top part by means of bolts which pass into the buried plate through the sand of the top box, and through a piece of iron crossing the bars of the top part. The nuts can be screwed down, thus holding the core firmly up to the top part. Cone pulleys of 3ft. and upwards are generally made in loam with boards as shown at Fig. 151, the internal flange or ring being formed by the boards, and the strengthening arms and bosses set in as the loam is built up. These should be roughly finished as the mould is smoothed up after they are taken out. It is sometimes necessary to use a three-parted box in moulding cone pulleys. This occurs when a flange is required on the small speed, which causes a joint to be made at this part to allow of its being taken from the mould. The various examples given almost include the entire arrangement by which a cone pulley could be made to meet any particular case, so that no difficulty should arise in the preparation of the pattern. The same method as that used for Fig. 149 is also applicable to a belt pulley having arms cast at both ends, and in which case the pattern would be used as a corebox, though, owing to the rough usage to which it would be subjected, a corebox would be found cheaper in the end.

(To be continued.)

Storage Batteries in Central Stations.*

The author deals exhaustively with the determination of the most economical size of the storage battery, on the assumption that the following particulars are known:—(1) Load curve; (2) pressure at the feeding points; (3) loss in feeders; (4) efficiency of battery. As regards the machinery, he makes the assumption that on the day of greatest demand in winter the engines shall be worked at full power during the 24 hours. The method of calculation is shown on an example, for which purpose the author takes a station supplying, on the three-wire system, 10,000 simultaneously-burning lamps, each taking 0·55 ampère at 110 volts. The loss on each side of the zero wire in the feeders is taken at 10 volts, making the maximum station voltage 240 volts. The method of calculating is a series of approximations. First, the author determines the energy sent out at different hours throughout the day, taking feeder hours into account. The calculated values are plotted for one side of the three-wire system in a load curve. Its area represents the number of units delivered in the 24 hours, and this amounts in the example chosen to 1809·3 Board of Trade units. If there were no loss in the battery this would also be the work obtained from the steam dynamos, and the height of a rectangle of equal area with the load curve would give the output of the dynamos. This is the first approximation, and gives the engine-power too low. The area of the load curve above the rectangle thus determined represents the number of units which the battery has to supply. Adding one-third to this (which corresponds with the efficiency of 75 per cent. assumed for the battery), we get a new and larger value for the total units produced by the dynamos—viz., 2211·4 Board of Trade units, corresponding with an output of 92 kilowatts. This value again inserted in the diagram gives now a slightly reduced area for the battery discharge, and by adding one-third, and again finding the height of the equivalent rectangle, we get as a third approximation 2176 Board of Trade units for the dynamos.

Continuing the calculation in this manner, the author finds that the true value for the engine-power is 90·8 kilowatts, or a total daily output of 2180 Board of Trade units, whilst the batteries must

* Inst. C.E.: Foreign Abstracts.

deliver daily 869·6 Board of Trade units. This gives for the combined dynamos and engine-plant at the station an efficiency of 87 per cent., 13 per cent. of the total dynamo output being lost in the batteries.

Having thus found the size of dynamos and batteries, the author proceeds to calculate the rate at which current will be delivered, and finds that the maximum dynamo current will be 776 ampères, and the maximum current from the battery will be 1743 ampères, the total capacity of the battery being 7410 ampère hours. The relation between discharge current and capacity is represented by the formula $K\sqrt[3]{C^2} = m$, where K is the capacity in ampère hours, C is the discharge current, and m is a constant depending on the size and type of cell. In the case under consideration the battery would consist of four parallel series of 130 cells each, having jointly the capacity and discharge rate above given.

The author next considers the case of a central station in which the steam plant is run for 12 hours only per day, thus doing away with the second shift of men which is required in continuous running. The effect of shortening the running time of the engines is to increase the size of the engines and diminish the size of the battery. The article also contains an investigation of the effect of switching regulating cells in and out.

Machine Construction.

THE CONSTRUCTION OF MACHINE ELEMENTS.

(*Continued from page* 34.)

CHAPTER VIII.

AXLES.

§ 129.

VARIOUS KINDS OF AXLES.

AXLES may be considered as beams which carry revolving or oscillating loads, and hence are provided with journals at certain portions of their lengths. They may be subjected to deflection or to compression, as in the cases of journals already discussed, according as the load acts normal or parallel to the axis. Axles which are subjected only to thrust are not often found, the far greater portion being those bearing deflecting loads, although many are under combined stresses.

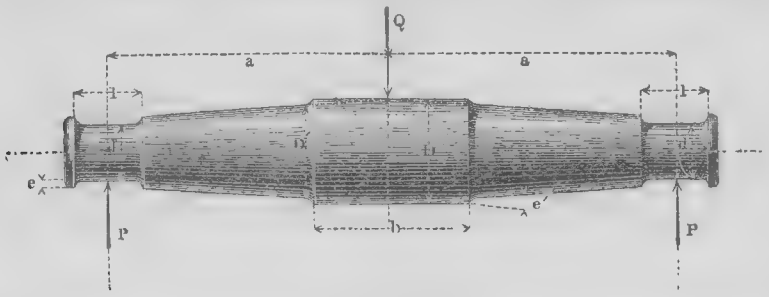


FIG. 386.

These may be divided into two classes—those which have the load applied at but one place, and those in which several loads are borne at various points. The first are called simple-loaded axles; the second, multiple-loaded axles.

The sections of axles of cast or wrought iron may be either circular or varied, and this gives rise to another sub-division in the calculations. The methods of graphostatics are especially applicable to the subject of axles, and in the following pages both numerical and graphical solutions will be discussed.

(*a*)—AXLES WITH CIRCULAR SECTION.

§ 130.

SIMPLE SYMMETRICAL AXLES.

The load Q is in this case applied normal to the direction of the axis, midway between the two journals, upon a seat for a hub, as shown in Fig. 386. The portion between the hub-seat and journals is called the shank of the axle. The journals are proportioned according to the methods given in Chapter V., taking $P = \frac{1}{2}Q$, and the axle then proportioned so as to give approximately the same strength as the journals throughout.

Let d = diameter, l = length of journals, e = height of shoulder or collar, D = diameter of middle or hub-seat, b = its breadth, D′ = diameter of shank at the junction with D, $e' = \frac{1}{2}(D - D')$ the shoulder at the latter junction, a = the length of shank. Then we have—

$$\frac{D'}{d} = \sqrt[3]{\frac{a - 0{\cdot}5b}{0{\cdot}5l}} \quad \ldots\ldots\ldots\ldots (121)$$

This will give the axle the same security as the journal, so that the approximate stress will be S = 8500lb. for wrought iron, and 4260lb. for cast iron. If a higher or lower stress is desired, the journal should be proportioned for the desired stress, and the corresponding dimensions for the axle deduced.

The strongest form for the shank of an axle is that of a cubic parabola (see § 10, No. VI.), and the student will find this a valuable subject for investigation. In practice it is made a portion of a truncated cone whose larger diameter = D′, and the smaller diameter = $d = 2e$. The value of e' should only be made large enough to provide sufficient depth for a keyway.

§ 131.

NON-SYMMETRICAL SIMPLE AXLES.

If the two shank portions of a simple loaded axle are of unequal length, as in Fig. 387, the load on the two journals d_1 and d_2 will be unequally divided, and we have the proportion—

$$\frac{P_1}{Q} = \frac{a_2}{a_1 + a_2}, \frac{P_2}{Q} = \frac{a_1}{a_1 + a_2}, \frac{P_1}{P_2} = \frac{a_2}{a_1} \quad (122)$$

The hub-seat divides the axle into two parts, each of which may be considered as the half of a symmetrical axle, and so the whole proportioned. The value of D′ is determined for each shank, and the greater value taken for both sides. If $a_1 = a_2$ the axle becomes symmetrical.

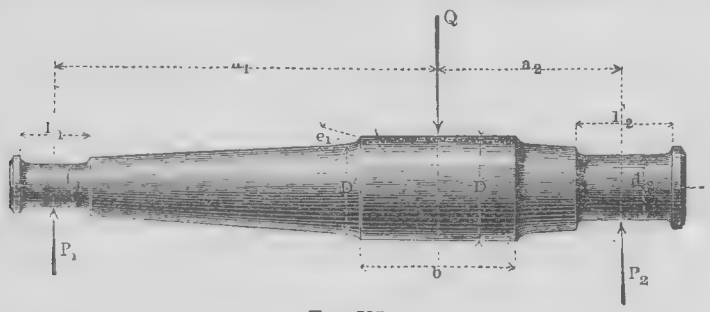


FIG. 387.

If the seat for the load Q does not lie between the two journals, but projects, as in Fig. 388 (a_2 becoming negative), the load is said to overhang, and the journal D becomes a neck journal (see § 92).

We have for the relations of forces—

$$\frac{P_1}{Q} = \frac{a_2}{a_1}, \frac{P_3}{Q} = \frac{a_1 + a_2}{a_1}, \frac{P_1}{P_3} = \frac{a_2}{a_1 + a_2} \quad (123)$$

The diameter of the journal d_1 is first determined, then a diameter for an assumed journal d_2 for the loaded point, and then a value D for a neck journal, taking for D the greater of the values for D′ and D″, as given for the two ends by formula (121), the length of journal being made $l_3 = \sqrt{l_1^2 + l_2^2}$.

The cubic parabola is shown drawn in the shank a_2, being the shape for uniform resistance in this case, and we have for the diameter δ, at the root of the hub-seat—

$$\frac{\delta}{d_2} = \frac{\sqrt[3]{l}}{\sqrt[3]{l_2}} \quad \ldots\ldots\ldots\ldots (124)$$

See § 10, Case VI., Remark.

Example.—Let the load Q, acting in one direction, be 14,520lb., a_1=47 25in., a_2=23·625in., b=3in., material cast iron, number of revolutions, n=150.

We have $P_1 = 0{\cdot}5$, Q=7·260lb. P_2=1·5, Q=21,780lb. From the table of § 91 we have d_1=about 3⅜in., d_2=about 6⅛in., also l_1=5⅛in., l_2=9⅜in. We then have—

$$D = 6{\cdot}25\sqrt[3]{\frac{23{\cdot}625}{4\ 6875}} = 10{\cdot}72, \text{ say } 10\tfrac{3}{4}\text{in.}$$

$$l_3 = \sqrt{(5{\cdot}625)^2 + (9{\cdot}375)^2} = 10\ 93, \text{ say } 11\text{in.}$$

$$\delta = 6{\cdot}25\sqrt[3]{\frac{13}{9{\cdot}375}} = 6{\cdot}97, \text{ say } 7\text{in.}$$

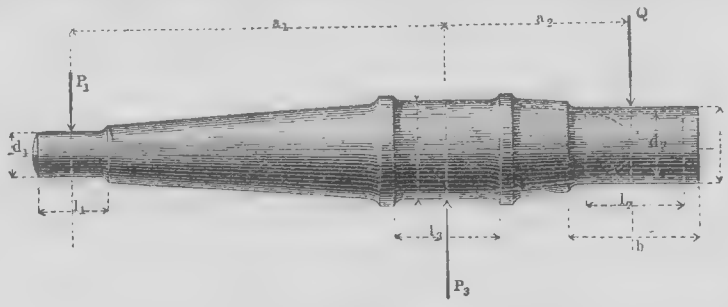


FIG. 388.

§ 132.

GRAPHICAL CALCULATION OF SIMPLE LOADED AXLES.

The determination of the forces acting upon the journals may be made according to the methods given in Cases I. to V., of § 39. In a similar manner the cord polygon may be employed, as in § 43 and § 44, to determine the statical moments of the parallel forces at various points, and the polygon so constructed may be called the surface of moments. The simple method about to be given will serve as a general graphical solution of the problem.

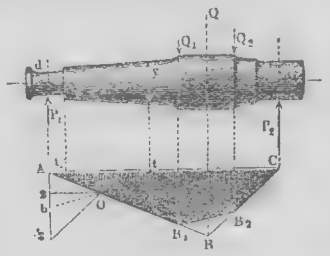


FIG. 389.

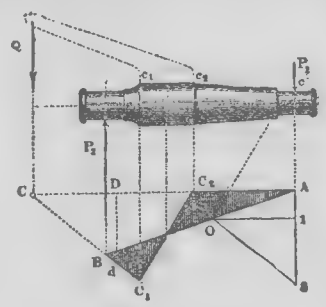


FIG. 390.

I. The Load Acts Normal to the Axis.—(*a*) *Hub and Load between the Journals* (*Fig. 389*).—Draw the line A C equal in length to the distance between centres of journals, and upon it construct any triangle A B C, whose apex lies on the line of the load Q. Draw A 3 normal to A C, making A 3 = Q; draw 3 O parallel to B C, and 2 O parallel to A C; then A 2 = P_1; 2 3 = P_2. By dropping the perpendiculars from the ends of the hub-seat we may divide Q into two forces, Q_1 and Q_2, shown in the force polygon by O b, parallel to B_1 B_2; giving A b = Q_1; b 3 = Q_2. The vertical ordinate t, at any point of the surface of moments, is proportional to the statical moment M y at its point of intersection with the axis, as for example the ordinate t_1, at the base of the journal for P_1. We have in any case—

$$y^3 = \frac{32}{\pi S} M y. \qquad d_1^3 = \frac{32}{\pi S} M_1;$$

and hence—

$$\frac{y}{d_1} = \sqrt[3]{\frac{M\,y}{M_1}}, \text{ or } = \sqrt[3]{\frac{t}{t_1}} \ldots (124),$$

from which y can readily be obtained.*

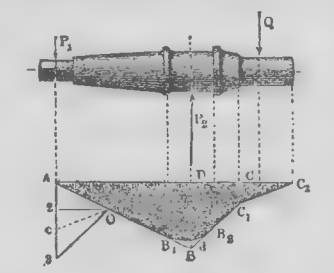


FIG. 391.

(*b*) *The Hub seat between the Journals and the Load Overhung* (*Fig. 390*).—Draw the line A C parallel to the axis, construct a triangle with the points A, B, and C on the lines of the direction of the forces, drop a perpendicular from the point D, where D d = Q, make O 1 parallel to A C, and equal to C D; make A 1 3 normal to A C, also O 3 parallel to C B, and 1 3 will = Q; A 1 = P_1; 3 A = P_2. The force Q is decomposed into two forces at the ends of the hubs, and by dropping the perpendiculars, the points C_1 and C_2 are determined, and O c drawn parallel to C_1 C_2, giving the values c 3 and 1 C for the forces at C_1 and C_2 respectively. The diagram shows that at a point within the hub-seat the stresses are reversed and the bending moment is zero.

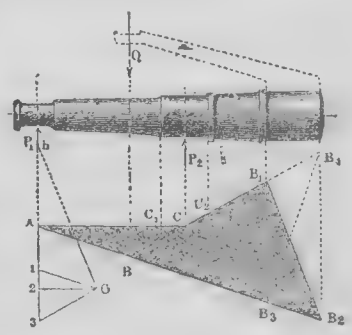


FIG. 392.

(*c*) *Overhung Axle with Load Outside the Journals* (*Fig. 391*).—Construct the triangle A B C as in the preceding case (*b*), and place D so that D d=Q, draw A 3 normal to A C, make O 2=C D, and parallel to A C, and draw O 3 parallel to C B, and we have again A 2=P_1; 3 A=P_2. Divide Q into C_1 and C_2 and make O c parallel to C_1 C_2, giving c 3 and 2 c for the forces at C_1 and C_2. The journal at B being uniformly loaded, its moment surface is outlined by a parabolic curve (see § 42).

(*d*) *Overhung Axle, with Load between Journals* (*Fig. 392*).—Construct the triangle A B C as in case (*a*), divide Q into B_1 and B_2, which gives the polygon A C, B_1 B_2, which is equivalent to the other one A C, B_4 B_3. In the force polygon 1 3 = Q, 2 1 = P_1, 3 2 = P_2, and by making O l parallel to B_2 B_1 we get b 3 and 1 b for the forces on B B_3 and B_2 B_4.†

(*To be continued.*)

Marine Engine Design.‡

IN this article it is proposed to deal with some points in marine engine design, treating the subject from a practical standpoint, and setting forth the considerations that should be taken into account, but only touching incidentally on the questions of proportions, which cannot be fully treated of in the compass of an article. The designer will be mainly governed by the service required of the vessel, and on this basis marine engines generally may be classified as follows: (1) machinery for navy vessels of small displacement and high power, such as torpedo boats; (2) for larger high-powered navy ships, such as large cruisers and ironclads; (3) for mail steamers of great power and high speed, such as the "Atlantic greyhounds"; (4) for mail steamers of moderate power and speed for long voyages; (5) for high-powered river or channel steamers; and (6) for cargo vessels. The general design of the machinery will always depend largely on the draught of the proposed ship, but there are many other considerations peculiar to each class. In class 1 it is highly important that the weight be reduced to a minimum consistent with

* If it is desired to terminate a series of values of t, beginning from t_1, it may readily be done by using a table of cube-roots of numbers; if the greatest value of y is the starting point, the table of cube roots of decimal numbers is useful, the space being divided into ten parts and the outline laid off correspondingly.

† The conditions of this case, but with very slight stresses, are found in the spindles of the American ring spinning frame.

‡ This article has been awarded a prize in our Monthly Competition.

proper strength and stiffness, cost of production and economy of fuel being secondary considerations, but not to be lost sight of. Some devices, however, for saving weight may not be worth the expense or loss of economy involved, as they entail extra weight and cost of coal. Other points of the first moment are that the engines be well balanced to reduce vibration, that the space occupied be the minimum, and that the vessel have good steering powers. As the machinery usually works at a much reduced speed, the designer may fairly allow a rather severe stress on the mechanism at full power, but to compensate for this he must exercise great care in the design, introducing special safeguards, and making the best choice and distribution of the material. He must see that he gets full value for every hundredweight used. In class 2 weight and space occupied are also highly important, but economy of fuel is more considered here than in class 1, and this alteration in the relative value of weight and economy will have an influence on the design, making the machinery heavier. In this class the engines have to work rather more continuously than in the other, although at much reduced powers as a rule. With these modifications the remarks relative to class 1 apply here also. In class 3 the first necessity is that the engines will work continuously at their highest power without hitch or breakdown of any sort, and this consideration should not be sacrificed to any other. But consistently with this, and with a moderate degree of economy, the weight should be a minimum. The designer should not allow himself to be hampered either as regards weight or space, and need not spare any necessary expense. These requirements are much the same for class 4, but economy of fuel here becomes more important and weight of machinery less so. In class 5 the weight should be a minimum consistent with working at full power the greater part of each day, and the space is usually very limited. To achieve these results, both expense and economy of fuel are largely sacrificed, but to what extent this is justifiable as regards the fuel depends somewhat on the length of the run, which governs the amount of coal to be carried. The latest tendency with this class is towards more economy. In class 6 the important matters are that the first cost and the cost of running be as little as possible, and this involves efficiency and endurance, but weight and space are secondary considerations. We have briefly reviewed the governing influences in marine engine designs of all leading types, but to assign to each element its proper relative value in each case is a work that must be done by each designer by the exercise of his own judgment, guided by reason and taught by experience.

As an example in designing, let us consider an engine of the usual triple-expansion type, intended for a cargo steamer, as this will probably be of more general interest than the other classes. We must bear in mind that economy in construction and fuel consistent with good working is the requirement. It unfortunately sometimes happens that cheapness of manufacture is allowed to predominate; but it does not pay the owner in the long run. Suppose our cylinders are 22in., 35in., and 58in. diameter, the stroke 3ft. 6in., and the revolutions 65 per minute., the I.H.P. being about 1000: We must first choose whether to have a steam jacket or not; but without presuming to enter into all the pros and cons here, suffice it that for this case, having regard to the probable state of jackets at sea in cargo steamers, the writer is of opinion that it would not pay to have steam jacketing, without disputing that some slight economy would attend the practice if carried out in an ideal manner. It would be better, however, to fit a liner of hard close-grained cast iron in the H.P. cylinder. As the wear here is apt to be greater than in the other cylinders, and as the surplus strength is less, the wear becomes more damaging. If the liner be fitted in a simple manner the expense will not be great, and is worth incurring. There should be about ¼in. allowance for wear on the thickness of the other cylinders—certainly not less than this. We would select a piston valve for the H.P. cylinder, and double-ported slide valves for the others; for although slide valves are generally preferable to piston valves, on account of their smaller clearance spaces, more direct passages, cheapness, and the little trouble they give, still the balance of opinion and experience is against their use for the H.P. cylinder, on account of the high steam pressure (assumed to be 150lb. per square inch).

We have now to consider the arrangement of the cylinders and valves, and will select the usual order for the cylinders—the H.P. forward and the I.M.P. in the middle,—as there does not appear to be sufficient reasons for the long receiver passages attending different arrangements. Regarding the valves, we would place the H.P. valve aft of the cylinder, and the other two forward of their respective cylinders—that is, the H. and I.M.P. valves between the H. and I.M.P. cylinders, and the L.P. valve between the I.M. and L.P. cylinders. Of course all the cylinder castings would be bolted together in a snug manner, presenting a plain and simple appearance outside. The advantages of this disposition of the valves are (1) simple and direct receivers, reducing the loss of heat at these parts; (2) cheapness, owing to the simplicity of the cylinder construction; (3) interchangeability of the cranks, as the centre lines of the cylinders are equidistant; (4) small eccentric pulleys, none of them being on the couplings; and (5) accessibility of the working parts. The chief objection to the design is the length of the engine down below taking up rather much space at that part, but as this gives rise to the advantage of accessibility, and as the room can usually be spared, the objection is counterbalanced by the numerous advantages mentioned. But it also involves longer condenser tubes than is desirable, but not to a serious extent in an engine of this size. In this connection it is assumed that the condenser runs fore and aft, and supports the back columns.

We will now consider some of the details of construction, commencing with the piston, which may be either of cast iron hollow or of cast steel single thickness, dished. The former is a little cheaper, and the latter a little better; but as in this case the piston speed is not sufficiently high to reap much benefit from the lighter piston, the claims of the two materials seem to be pretty evenly balanced. But if advising or acting for owners, the writer would choose cast steel. Ramsbottom rings may be used for all the pistons, as they are quite cheap, cause but little friction and wear, and, when properly made and attended to, give every satisfaction. The rings should be made as follows:—There should be three cast-iron rings in each piston, made concentric, the thickness varying from 1⅛in. to ⅝in. at the cut part, the joints being half lapped, and the diameters of the rings uncut being 22⅝in., 36in., and 59¾in. When cut the rings should be sprung in, and the outer edges finished in the lathe to the diameters of the cylinders. The vertical depth of the middle ring should be 1in., the top one being ⅛in. less, and the bottom one ⅛in. more, the spare ring being ⅛in. thicker than this again. When the rings have worn a little on the top and bottom faces, the upper one can be removed, the others lifted a step, and the spare ring placed in the bottom groove. The cylinder barrels should have an easy bevel top and bottom, and the outer edges of the outer rings should reach slightly beyond the beginning of the bevel when the pistons are at the ends of the stroke, so that no shoulders be formed through the wearing of the barrel. The use of the bevel at the top is to enable the pistons with rings in place to be entered easily, but many makers merely form a shoulder with fillet at the bottom, and no slanting surface at all, which is not good practice, especially with thin packing rings, as the bottom ring may reach entirely beyond the wearing surface of the barrel on some special occasions—when trying the bottom clearance, for instance, by allowing the piston to rest on the bottom of the cylinder and observing the position of the crosshead. This may seem a trivial point to many; but the writer has known of instances where this oversight has caused much trouble and expense.

We have next to consider the piston rods, and this opens up the question of tail rods. The advantage of having them is a slightly steadier movement of the pistons, resulting probably in rather less wear of the barrels. The objections are the friction and trouble with the stuffing boxes, especially in the case of the H.P. rod; also the additional weight and expense. To avoid the first difficulty, the rods are sometimes passed through sleeves into domes, but this increases the clearance somewhat, and is rather costly. Some engineers use a dome for the H.P. rod and stuffing boxes for the others, and some have no tail rods at all in the H.P., either stuffing boxes or domes being used for the I.M. and L.P. rods. Others do without tail rods at all, and with good results. For the engine under our notice, the latter plan might be adopted, making the piston rods rather larger in diameter in the body, to compensate in some measure for the absence of tail rods. This would also enable us to form a slight shoulder on the rod where it enters the piston, as a safeguard against the rod being drawn into the piston. The amount of taper of the rod in the piston is of great importance, as too little is apt to split the piston and make it very difficult (sometimes impossible without spoiling something) to withdraw the rod after it has been working for some time. A taper of 3in. per foot on the diameter, combined with the shoulder already mentioned, serves very well in practice.

The cylinder covers will, of course, be of cast iron, the H.P. being of single thickness, strongly ribbed, and the others double thickness. They will be sunk into the cylinders—that is, the steam ports will be formed in the cylinder castings, the cover flanges being round. Sometimes a different design of cover is adopted, the cover joint being about in line with the top of the cylinder working barrel, and the steam ports being formed in the covers. The chief merits of this plan are that it saves some weight, and that it can be properly drained when used for jacket steam; but it is dearer than the other design mentioned, and renders it difficult to get the nuts on and off the studs. As it is impossible to deal with the whole design in one article, we will conclude at this point for the present.

WH. SC.

Utilisation of Water Power.

(*Continued from page* 49.)

Breast Waterwheel.—This wheel differs from the overshot in receiving the water about the level of the axle. It is sometimes classed under two heads—high breast and low breast. The effective horse-power of the high breast $=0{\cdot}00113\ Q\ h$. Quantity of water in cubic feet per minute $= \frac{881 \text{H.P.}}{h}$.

Effective horse-power of the low breast $=0{\cdot}00104\ Q\ h$. Quantity of water in cubic feet per minute $= \frac{961 \text{H.P.}}{h}$.

In order to permit all these wheels to work with freedom and to the greatest advantage, it is necessary that the back or tail water should have an uninterrupted passage off, for otherwise it accumulates and forms a resistance to the float-boards.

Turbine.—The name is derived from the Latin *turbo*, a whipping-top, from the similarity of the motion. The turbine is a development of the waterwheel, and comprises any wheel driven by water escaping through small orifices, the revolution of which is due to the pressure derived from falling water. The horizontal turbines are much the commonest. Barker's centrifugal mill was the first type constructed, acting not by the weight or momentum of the water, but by the reaction caused by the water issuing out of horizontal tubes having apertures in opposite directions. Improved turbines based upon the principle of Barker's mill have from time to time been invented. The first chief improvement was by Fourneyron, who in 1827 constructed a machine by which the force of the water is more completely utilised. In this machine the water is supplied by a vertical pipe, but instead of at once escaping through radial arms it first passes over a fixed plate through a number of channels curved in such a manner as to give the water on leaving these channels a direction tangential to the circumference of the plate. From these channels the water passes into similar channels in the revolving wheel curved in the opposite direction, and finally escapes at the circumference of the wheel. Turbines such as Fourneyron's, in which the water is supplied at the centre and flows outwards, are called outward-flow turbines; and those in which the water is supplied at the circumference and escapes by an orifice at the centre, are called inward-flow turbines.

Turbines are much smaller than ordinary waterwheels, but revolve much more rapidly. They can be placed in almost any situation, water being led to and from them in pipes. They occupy far less space than waterwheels, and are easily fixed They will work in any depth of water, giving the proportionate power that is available between the head and tail water. They give a higher percentage of power with a given quantity of water than is obtainable with other waterwheels. Gear for increasing the driven speeds with ordinary waterwheels is dispensed with. The first cost of turbines, except those for very low falls, is less than for ordinary waterwheels made in iron, of corresponding power. Where the fall of water is small they yield a better, but where it is great, a worse result than the other wheels. Where, however, the fall is more than 40ft., ordinary waterwheels cannot, as a rule, be conveniently used, while turbines can be used for falls of several hundred feet. Turbines are, therefore, best adapted for small and very great falls, and the ordinary waterwheels for moderate falls of water.

Jonval's low-pressure turbines are suitable for falls of 30ft. and under. They are either fixed in pentroughs or inside a closed case, according as the fall is great or small.

The effective horse-power of turbines $=0{\cdot}079\ Q\ h$. Quantity of water in cubic feet per second $= 12{\cdot}6\frac{\text{H.P.}}{h}$.

The volume of many streams could be increased by leading smaller streams into the one channel, should an increased power beyond that existing be necessary. Under many conditions the water, after leaving the turbines and other motors, would flow on without in the least interfering with the existing rights of millowners and others.

Hydraulic Rams.—Hydraulic rams are used for the raising of water only, and are actuated by the weight of the water which they have to raise, or other source of energy—such as sewage water. The useful effect is nil when the lift reaches 26 times the fall, and no delivery can then be expected. The lifting capacity of hydraulic rams is very small comparatively, and as they do not provide motive power, municipal engineers can find little use for them. The effective horse-power of the ram $= 0{\cdot}00113\ Q\ h$. Quantity of water used in cubic feet per minute $= \frac{881 \text{H.P.}}{h}$.

Water-pressure Engines.—Water may be brought to act upon the piston of an engine in precisely the same way as steam acts in a steam engine, the pressure being according to the head of water utilised. There is a considerable loss of energy in the flow of water due to friction, consequently a water-pressure engine must be run at a much less speed than a steam engine, the frictional losses of energy in a fluid being proportional to its weight. A steam engine has a piston speed of 400ft. or 500ft. per minute; a water-pressure engine rarely has a speed exceeding 80ft. per minute. It is just when an exceptionally high pressure can be obtained, or requires to be used, that the water-pressure engine is most applicable. One of the drawbacks of this type of engine is that the same amount of energy must be expended each stroke, whether the load is heavy or light. These engines work with good efficiency when the fall and lift are constant, and when quite proportioned to the work to be done. The effective horse-power of a water-pressure engine $= 0{\cdot}00151\ Q\ h$. Quantity of water in cubic feet per minute $= \frac{661 \text{H.P.}}{h}$.

(*To be continued.*)

Shipbuilding Notes.

A new ironclad which has just been completed for the German Navy was successfully launched at Kiel on the 6th inst.

The second-class cruiser "Intrepid" made a very successful contractor's trial of her engines at Portsmouth on the 4th inst.

The London, Woolwich, and Clacton Steamboat Company have placed an order with Messrs. William Denny and Brothers, of Dumbarton, for the construction of a new paddle steamer.

On the 29th ult., the steamship "Arpad," built and engined by Messrs. Wigham, Richardson and Co., went for a trial trip. She is 240ft. in length by 33ft. beam, and is fitted with triple-expansion engines, which worked admirably on the trial trip, driving the vessel fully laden at a mean speed of 12 knots.

The s.s. "Warrenpoint," recently launched by Messrs. John Fullerton and Co., Paisley, went down the river on the 3rd inst. on her official trial trip. A speed of 10½ knots was attained on the measured mile. The machinery, which was supplied by Messrs. Ross and Duncan, Govan, worked most satisfactorily all day.

The Admiralty have entered into a contract with Messrs. Yarrow and Co., of Poplar, for the immediate construction of a small paddle steamer, to have the least possible draught practicable, for the navigation of the Upper Shire. The steamer is to be 60ft. in length by 14ft. beam, and will have a draught of 11in., and speed of from eight to nine miles an hour.

A new steamer, built by Messrs. John Jones and Sons, of Liverpool, for the Sligo Steam Navigation Company Limited, went on her trial trip in the Mersey on the 4th inst. The dimensions are:—Length between perpendiculars, 206ft.; breadth, moulded, 29ft.; and depth, moulded, 15ft. 3½in. Her gross tonnage is 700, and net 332 tons. The engines are triple expansion, constructed by the builders, and are of 1000I.H.P. The high-pressure cylinder is 21in. in diameter, intermediate 34in., and the low-pressure 54in., all of 36in. stroke. Steam is supplied by two single-ended boilers 13ft. in diameter and 10ft. 6in. long. On the trial the vessel attained a speed of 13 knots, being a knot in excess of contract speed.

Recent Boiler Explosions.

(*Continued from page 8.*)

REPORT 542 refers to the explosion of a vertical boiler used for hauling up the trawl gear in an east coast fishing vessel. A "preliminary inquiry" only was held, the surveyor being unable to ascertain any particulars, as the boiler was blown into the sea. Still, we think he might have gained some information as to the name of maker and age of the boiler. However, seeing the boiler was not likely to be recovered, he appeared to think these particulars were of no importance.

No. 543 is a record of the failure of still another copper steam pipe; fortunately no one was injured. After the full comments we have from time to time made on these mishaps, it would be idle to further dilate upon the matter here. We believe the days of copper pipes of large diameter are numbered, as they are in many cases being replaced by pipes of wrought iron or mild steel. The pipe in question appears to have been repaired on more than one occasion.

No. 544 is a formal investigation into the bursting (or rather burning through) of a water pipe in a firebox of a vertical boiler. Compared with No. 542, this was only a trifling affair and of no moment, as at the worst it only amounted to putting out the fire. But while the explosion referred to in report No. 542 practically destroyed the vessel, and was not even investigated, the owners of the boiler now under consideration had to pay £25.

No. 545 refers to the bursting of a small cast-iron steam chest, in the cover of which wax was melted for printing purposes. As is customary, the chest was formed of flat surfaces of cast iron, so that it was weak in more than one respect.

No. 546 cannot well be classed as an explosion, as it was merely the collapsing of a small tube in a locomotive boiler, occurrences which are taking place nearly every day on all our main lines. The tubes when new are necessarily thin, and are further reduced by scouring, and eventually collapse with no greater disturbance than the putting out of the fire.

No. 547 refers to the collapsing of the furnace tube of a Cornish boiler, which collapsed from sheer weakness, although only recently examined by a so-called boiler inspector. How ever any person with even a limited knowledge could pass such a flue as safe we cannot tell. But it was passed, and ultimately came to grief by collapsing and tearing.

No. 548 refers to the rupture of a firebox plate of a locomotive boiler, killing one man and injuring six others. Apparently from the report the water-space had become partly choked, which would tend to overheating, when the tenacity of the metal would be reduced. The Commissioners, however, did not blame anybody.

No. 549 records the explosion of another vertical boiler, which was purchased second-hand, without regard to condition or age, and was not examined by any inspector. The Commissioners held the owners to blame, and fined them £15.

No. 550 refers to an explosion of a small boiler of irregular shape, and probably of very great age. The actual pressure employed does not seem to be known. The plates were badly corroded, and the top was blown off, injuring five persons. The owner relied on a so-called engineer, who was fined £5 as a warning to others who may represent themselves as engineers when they really are not.

No. 551 refers to the explosion of a vertical boiler by thinning of the firebox plate, a portion of which was blown out, scalding one man. The owner was considered to blame, and fined £15 as a salutary caution.

(*To be continued.*)

Notices of New Books.

THE HISTORY OF THE BAND-SAW. By W. SAMUEL WORSSAM, C.E. Manchester: Emmott and Co. Limited. 1s. 6d.

MR. W. S. WORSSAM, who is well known as the patentee of a very large number of improvements in wood-working machinery, as well as a manufacturer of plant of this description, has, in the work under consideration, given a very succinct and interesting account of the development of the band-saw. In the first three chapters the author gives an historical account of the saw, commencing with a description of Newberry's machine (1808), and tracing the successive improvements which have been effected down to the present time. Chapters 4 and 5 treat on the quality and manufacture of band-saws, while sharpening and setting is dealt with in Chapter 6. The latter section contains a large amount of practical information, which is well elucidated by the aid of a number of illustrations. The usual method of brazing band-saws is thus described in the following chapter:—

"The two ends of the blade are first squared, and then filed to remove rust or any other foreign substance that may interfere with the brazing; the ends are next tapered or scarfed and placed together, forming a lap of from ¼in. to 1½in. long, according to the width of the saw, care being taken that the back of the saw is in line, that the teeth correspond with each other, and that sufficient thickness be left for cleaning-off after brazing; next the joint is bound together by two pieces of iron wire, as close to the ends of the blade as possible, and then encircled with brass brazing wire. It is this brass wire which in melting makes the joint. The saw is then placed on the iron cramp or appliance held in a vice, and secured by two small hand-vices.

"The joint is moistened with water and covered with borax to make a flux. The blade is next placed in the centre of a well-lighted charcoal fire on a small portable forge, with circular bellows worked by the foot, and having the hearth fitted with receptacles for holding water, charcoal, etc. Care must be taken to concentrate the heat on the joint only, so that the temper of the saw on either side of it shall not be destroyed. The saw is held in position on the hearth by small weights. It is then covered with charcoal, and the bellows are worked until the flame takes a yellow hue, which shows that the brass wire is melted; after a few moments the saw is removed and allowed to cool in the air. It is subsequently fastened to a light wooden bed, the binding wire removed by a small cold chisel, and the joint filed to the same thickness as the rest of the blade. The saw is afterwards re-dressed by a hammer on an anvil, and finished off with emery-cloth. In some cases, for small saws, instead of the forge, brazing-tongs are used. The saw is prepared as in the preceding case and secured to the iron cramp or appliance; the jaws of the tongs, previously heated to a white heat, are closed over the joint, thus melting the brass wire; the saw is then finished off as in the other operation."

Band-saw guides are discussed in Chapter 8, and a brief description of the band-saw machine for heavy straight work, now extensively used in the United States, concludes this interesting little treatise.

Mr. Worssam's eminently practical acquaintance with the subject has well qualified him for the task he has undertaken, and which he has discharged in a highly creditable manner. We can unhesitatingly recommend the work to those who are in any way interested in this class of wood-working machinery.

FIRST PRINCIPLES OF MECHANICAL ENGINEERING. By J. IMRAY and C. H. W. BIGGS. London: Biggs and Co. 3s. 6d.

THIS work is described on the title page as "being an attempt to provide an elementary book, and to treat the subject without any but simple mathematics," and we may say at once that the authors have succeeded in their endeavour, and have produced an elementary treatise on mechanical engineering for which a want has long existed. The first chapter is introductory in character, being mainly devoted to definitions and explanations of the fundamental terms used in engineering. The second chapter comprises a treatise on mechanical drawing, which is in the main well written. We are of opinion, however, that the subject of shades and shadows, which occupies thirteen pages, is treated at inordinate length. A very useful chapter follows on the "Strength of Materials," which receives very full treatment. Chapter 4 deals with "Sources of Mechanical Power," water wheels receiving special attention. In Chapter 5, heat, steam, and the steam engine, etc., are treated on. The next chapter is on the "Transmission of Energy," and includes the consideration of couplings, pulleys, gearing, forms of wheel teeth, cams, etc. In the final chapter, chemical action is briefly considered. The book is one well calculated to interest the tyro in mechanical engineering, for whom, we presume, it is mainly intended. As an introduction to the study of engineering mechanics, the book should unquestionably prove of value, more especially as mathematical treatment of the subject has been generally avoided, and a simple and lucid style adopted throughout. Some of the illustrations might be improved with advantage, notably the cut of a plummer block on page 310, which is very crude. The book is well printed and bound, and deserves to become popular.

STEAM BOILERS: THEIR DEFECTS, MANAGEMENT, AND CONSTRUCTION. By R. D. MUNRO. London: Charles Griffin and Co. Limited. Second Edition. 3s. 6d.

IN this work Mr. Munro, who is the chief engineer of the Scottish Boiler Insurance Co., has supplied boiler attendants, as well as boiler makers and inspectors, with a large amount of really practical information bearing upon the construction and treatment of steam generators. In the second edition of the work several additional matters have been dealt with. A special section on the construction and management of vertical boilers has been introduced, together with a number of tables of riveted joints and bursting pressures. We are of opinion that Mr. Munro has done well to give so much attention to the construction of the much-used upright boiler, especially as a somewhat large number of accidents with this type have been recorded during recent years. No doubt, as Mr. Munro contends, this boiler suffers greatly from mal-construction and bad workmanship, but the conditions under which it is frequently worked, and the careless supervision it receives, are also portent causes. Careful design and good workmanship are therefore indispensable in this type of steam generator, and those who are engaged in its construction cannot fail to profit by a perusal of Mr. Munro's remarks and criticisms thereon. A specification and detailed drawing of a Lancashire boiler for a working pressure of 200lb. per square inch is appended, and the work generally brought up to date. There are only a very few good books available on steam-boiler construction, and Mr. Munro's is certainly one of them.

NOTES AND EXAMPLES IN MECHANICS. By IRVING P. CHURCH. New York: John Wiley and Sons.

MR CHURCH, who is one of the professors of Civil Engineering at Cornell University, is well known as the author of a very useful treatise on the "Mechanics of Engineering," of which work that under consideration may be considered a companion volume. It consists mainly of a collection of notes and examples designed to illustrate the application of fundamental principles in the mechanics of solids. The first five chapters consist for the most part of a collection of the usual examples given in books on mechanics, and do not call for special remark. Chapter 6, on "Dynamics of a Rigid Body," is well written, but the most interesting portion of the work is comprised in Chapter 7, on "Mechanics of Materials and Graphical Statics," and in the appendix, "Notes on the Graphical Statics of Mechanism." The latter section is mainly based on Prof. Herrmann's "Zur Graphischen Statik der Maschinengetriebe," but the examples are simplified to some extent, and will be found to afford an exceedingly interesting and instructive study. We can cordially recommend Prof. Church's well-written treatise as a companion volume to the many excellent works on mechanics which have appeared within recent years.

SIMPLE EXPLANATIONS OF ENGINEERING FORMULÆ; DIRECT STRESS AND STIFFNESS. By R. W. WESTERN. London: B. T. Batsford.

IN this book various problems in direct stress and stiffness are solved by the aid of one formula of the integral calculus, which latter is fully explained in the introduction. It is assumed that the reader is sufficiently acquainted with elementary algebra and mechanics to be able to find the general expression for the bending moment or shearing force at any section of a beam, but beyond this no great acquaintance with mathematics is required. The author has endeavoured to explain the principle of the calculus in the first few pages of the book, and so far as his immediate object is concerned he has succeeded fairly well. We think that an earnest attempt to popularise the calculus and to show its application to various engineering formulæ would meet with favour, and as Mr. Western has shown so conclusively what can be done in a particular direction by the aid of only one formula, we hope he may be induced to extend the field of his labours.

THE ELECTRICAL ENGINEER'S POCKET-BOOK. By H. R. KEMPE. London: Crosby Lockwood and Son. Second Edition.

AS a second edition of this pocket-book has been called for within less than two years, it may be taken that the work has well fulfilled its intended purpose. The present edition has been thoroughly revised, and nearly 50 pages of new matter have been added, dealing chiefly with dynamos, transformers, electric motors, electric tramcar systems, electric launches, etc. We are pleased to find that some notes on steam engines are included in this edition, but there is still room for improvement in this section. Some useful trigonometrical tables are appended, which will enhance the value of this useful pocket-book.

Trade Notes.

The Grantham Crank and Iron Company Limited announce a dividend of 17½ per cent. for the past year.

The directors of the Midland Railway Carriage and Wagon Company Limited announce a dividend of 10 per cent.

Messrs. Heenan and Froude, of Newton Heath, Manchester, have contracted to supply the hydraulic lifts required for the Blackpool Tower.

The West's Gas Improvement Company, Miles Platting, are supplying some of their stoking machinery to the Elland Gas Company.

President Harrison has signed the Act limiting to eight hours the work of mechanics and labourers on public works in America.

Messrs. F. Suter and Co., of London, are fitting up a complete installation and generating plant on the premises of Messrs. Cowells, printers, Ipswich.

Messrs Siemens and Halske, of Berlin, have received the order for the electric lighting of the two new Cunarders now building at Fairfield, Glasgow.

The directors of the Naval Construction and Armaments Company Limited recommend a further dividend of 4 per cent., making 6 per cent. for the past year.

The Glasgow Water Commissioners have placed an order for 10,800 tons of cast-iron water-pipes with Messrs. Robert Laidlaw and Son, Alliance Foundry, Glasgow.

A large foreign order for steel rails of heavy section has recently been secured by a leading English firm at nearly 7s. per ton advance upon the price obtainable a month previously.

Mr. Simon, of Manchester, has received the order for the whole of the machinery required by the Scottish Co-operative Wholesale Society for their new flour mills at Leith, Scotland.

Mr. Robert Middleton, Sheepscar Foundry, Leeds, has acquired the whole of the patent rights of the briquette machinery which has hitherto been manufactured by him for Messrs. Yeadon and Co., Leeds.

Mr. H. Parfitt, of Ebbw Vale, has secured the contract for the supply of the iron roof and necessary columns and girders for the new grain warehouse of Messrs. Parnall, Evans and Co., at Riverside, Newport, Mon.

Messrs. Steel, Peach and Tozer, Rotherham, have put down a furnace for the manufacture of Siemens-Martin steel by the acid process, owing to the increase in the demand for axles and tyres produced by this process.

The contract for the electric lighting of the new offices now being built for Messrs. John Lysaght Limited, St. Vincent Ironworks, Bristol, has been secured by Messrs. King, Mendham and Co., electrical engineers, Bristol.

The Acme Ventilating and Heating Company, of Liverpool, have been awarded the contracts for heating and ventilating the Seamen's Hospital at Bootle, and for the ventilation of Pembroke Chapel (Liverpool) Lecture Hall.

Messrs. Kitson and Co., of Airedale Foundry, Leeds, have secured a large order for locomotives from the Great Indian Peninsula Railway Company. The firm have also completed an order for tank engines for the Mersey Railway.

Messrs. James Tucker Limited have erected a large flour mill at Cardiff, which is capable of producing 50 sacks of finished flour per hour. The engines—800H.P.—and the whole of the machinery have been supplied by Messrs. Whitmore and Binyon, of Wickham Market.

Tenders are about to be invited for the supply of the engines required for the cruiser "Cardenal Cisneros," which is now building at Ferrol. The machinery, which is to drive twin screws, is to develop 15,000H.P. under forced draught, and 10,500H.P. under natural draught.

The Cleveland ironmasters' returns for July show that there are 85 furnaces in blast, compared with 88 at this date last year. The total make of all kinds of iron in July was 196,163 tons, against 57,765 tons in June. The stocks are 50,992, compared with 48,472 in June, an increase of 2520; and the shipments have been 38,608 tons, against 31,694 in June.

Wheel cutter in metal only. Every description of gearing. R. CHIDLAW, 43, City-road, Manchester.

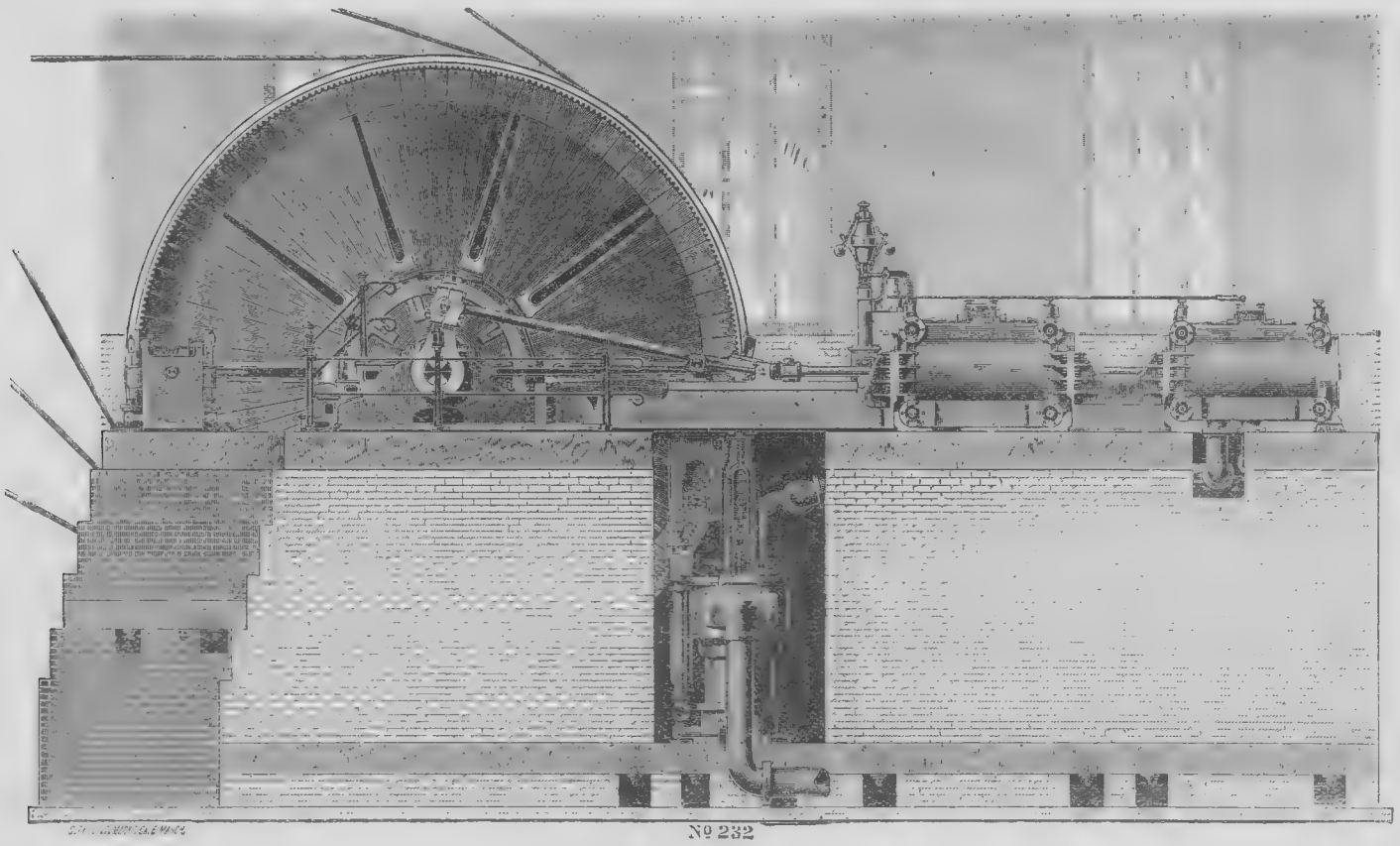
Having regard to the enormous circulation of THE MECHANICAL WORLD, the Editor suggests that it is by far the best medium for the insertion of every kind of "Wanted" advertisement, and the price is only one halfpenny per word. The Editor will be glad if MECHANICAL WORLD readers will kindly bear this in mind as occasion arises.

Triple-expansion Mill Engines.

We illustrate herewith the engines supplied by Messrs. John Musgrave and Sons Limited, Bolton, to the Milton Spinning Company, Mossley, which are of the horizontal four-cylinder triple-expansion type, being intended to develop 1200H.P. when working at 160lb. pressure. The diameter of the high pressure cylinder is 22in., of the intermediate 35in., and of the two low-pressure cylinders 39in. The stroke is 5ft., and the number of revolutions 60 per minute. The admission valves to all the cylinders are fitted with Messrs. Musgrave's patent trip motion, permitting the cut-off to be varied by the governor at from 0 to $\frac{3}{4}$ stroke. The exhaust valves have a positive movement from an independent eccentric, the release and compression taking place at fixed points, without regard to the point of cut-off. The engine bed is of the box girder type.

There are two air pumps, each 28in. in diameter, the bucket having a stroke of 20in. The diameter of the crank shaft at the centre is 22in., and at the necks 16in., the length of the bearings being 36in. The crank pins are 10in. long and 10in. in diameter.

The rope drum is 30ft. in diameter, and is grooved for 44 $1\frac{3}{8}$in. ropes, which run at the high velocity of 5657ft. per minute. The mill is not yet working at its full capacity, so that no tests are available as to fuel consumption at full power; but there is every reason to believe that, in view of the care bestowed upon the plant, the results obtained will be highly satisfactory.



No 232

Triple-expansion Engines.—Fig. 1.

Watertight Sub-division of Ships.

[CONTRIBUTED.]

The efficient sub-dividing of vessels has of late received much more attention than was the case a few years since; and this is more generally noticeable in the mercantile marine than in vessels of the royal navy. The latter having greater liabilities to damage of hull from explosion of torpedoes, etc., rendered consideration as regards effective sub-dividing one of the chief features of naval construction. This was not the case to such a large extent in the class of vessels not intended for war purposes; in fact, the sub-dividing merely consisted of transverse bulkheads, one collision, another at end of shaft tunnel, or stuffing box to shaft, and others enclosing the engine, boiler, and cargo spaces; and these not being of sufficient number or properly spaced to ensure the safety of the vessel, many losses may be attributed thereto.

The present development of affairs we may state as being attributable in one instance to the requirements of the British Admiralty as regards sub-dividing of such vessels as may be employed as armed cruisers, transports, etc., in time of war. Another cause is due to Lloyd's registry, which requires more efficient sub-dividing than was formerly adopted by the shipbuilders. Finally, the Board of Trade has been taking active measures in this matter, some details of which we quote further on.

It was considered by the Council of the Institute of Naval Architects, some 25 years since, that a vessel able to keep afloat with any two compartments filled would be sufficiently safe; at the present time this is considerably exceeded, and more especially in vessels of the royal navy, in which, perhaps, some six or more of the compartments may be injured and in free communication with the sea without endangering the safety of the vessel. This is mainly attributable to the horizontal sub-dividing, to which we shall refer.

A committee of later date, appointed by the Board of Trade to consider this important feature in ship construction, recommended that the sub-dividing of vessels should be classified by six grades, each of which to have the following qualifications:—

First Grade.—For vessels not less than 425ft. long. To float with any two compartments flooded.

Second Grade. — For vessels between 350ft. and 425ft. long. To float with any two fore-body and any one after-body compartments flooded.

Third Grade.—For vessels between 300ft. and 350ft. long. To float with any two or three foremost or any one of the after compartments flooded.

Fourth Grade.—For vessels under 300ft. long. To float with two foremost or any of the after compartments flooded.

Fifth Grade.—For vessels not less than 275ft. and over 300ft. long, not carrying passengers. To float with any one compartment filled.

Sixth Grade.—For vessels 260ft. to 300ft. long. To float with any one of the fore-body compartments filled.

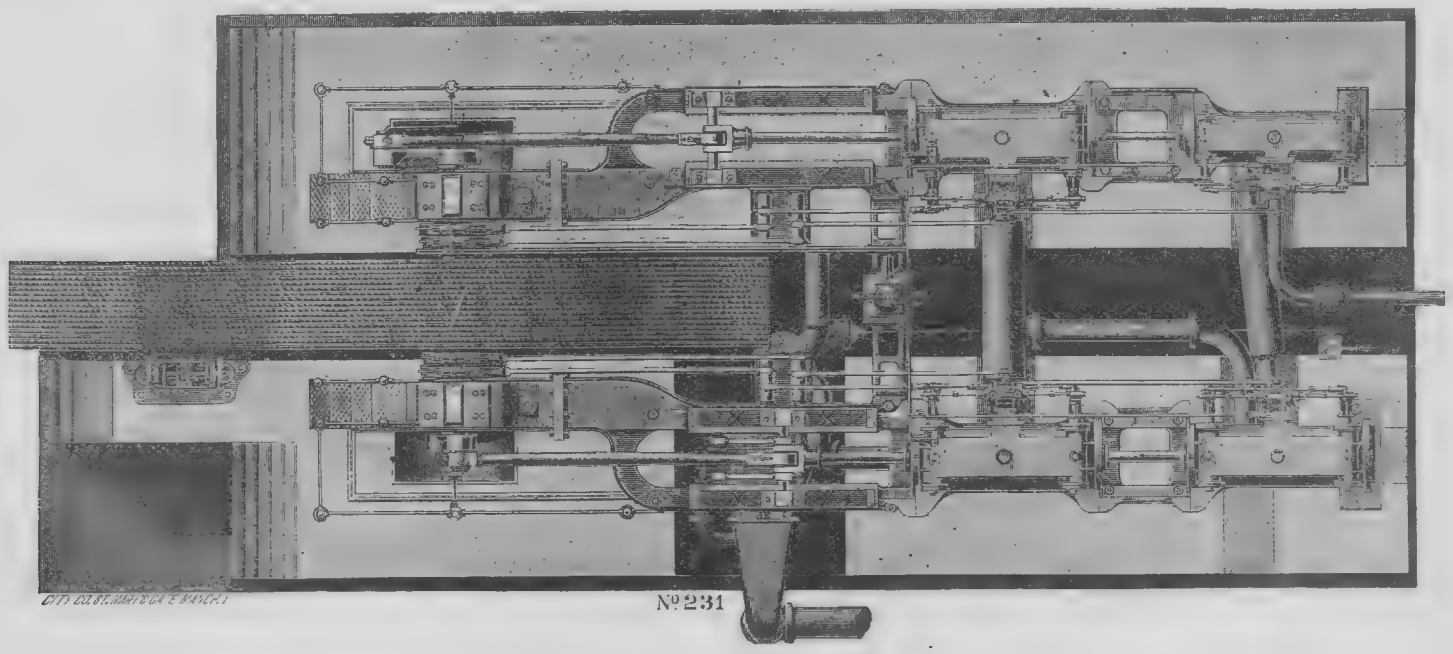
We do not in the present article propose to deal further with these latter requirements, but only give them as illustrating the development of this subject.

The system known as cellular or double bottom is being more generally adopted in the mercantile marine at the present time, thus adding another agent increasing the safety of vessels from foundering through damage to the outer skin, or bottom.

The general systems of watertight divisions are as follow:—

(I.) By transverse vertical bulkheads. (II.) By longitudinal and transverse vertical bulkheads. (III.) By horizontal flats or decks, longitudinal and transverse bulkheads. (IV.) By cellular or double bottom, with either of the above.

The detailed arrangement of the above may be illustrated as follows:—



No 231

Triple-expansion Engines.—Fig. 2.

I. (*a*) *Fig.* 1.—By means of transverse watertight bulkheads, extending vertically to a deck (not watertight), these being of sufficient number and height above the load water-line to ensure the tops not being reached in the event of the bottom becoming damaged, so that the compartment may be in full communication with the sea.

(*b*) *Fig.* 1.—As (*a*), but the deck being watertight, and at a distance 2ft. below the load water-line.

II. (*c*) *Fig.* 2.—By means of longitudinal and transverse vertical bulkheads running up as in (*a*), with deck not watertight.

III. (*d*) *Fig.* 2.—By means of longitudinal and transverse bulkheads, also horizontal flats or decks, all the divisions being watertight.

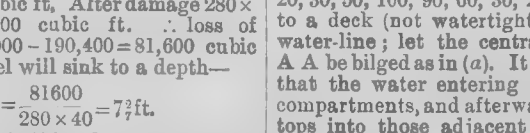
IV. (*e*) *Fig.* 3.—By cellular bottoms, in addition to any of the above, thereby rendering the chances of safety twofold, from the fact that in the event of the outer bottom being injured and the inner one intact, the water could get no farther, and the condition of the vessel as regards buoyancy unimpaired, the draught being increased slightly, at the same time the stability also.

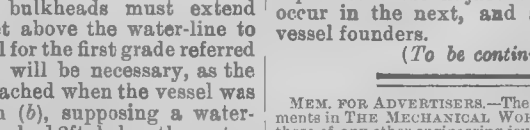
(*f*) *Fig.* 4.—This is an unsafe condition, where the vessel, insufficiently divided on being damaged, would founder on account of the water reaching the tops of the bulkheads and flowing into the adjacent compartment.

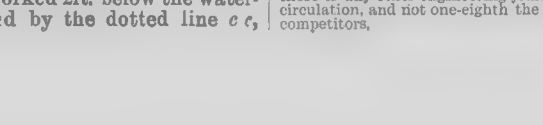
We will now proceed to investigate the effect of the different modes referred to above in the event of the hull being damaged and the compartments flooded. To do this we will use a vessel of the form of a parallelopidedon, or box, this form being the more convenient of illustration, and similar results will be attained as would be the case with vessels of curvilinear form.

In all cases let the vessel be 400ft. long, 40ft. broad, 30ft. deep, and having a draught of water equal to 17ft.

In (*a*) Fig. 1, assume the compartments to be in length, counting from the foremost end, as follows:—15, 35, 40, 50, 60, 60, 50, 40, 25, 25ft.







W L, Water line, intact condition - - -
W′ L′, Water line after bilging - - -
A A, Bilged compartments - - - -
C C, Water-tight deck and bulkheads -
Deck not water-tight - - - - - -
A′, Hole in bottom in last condition.
B, Collision bulkhead.

Now, supposing the two midship compartments to be bilged and in free communication with the sea, the buoyancy of that portion of the vessel is destroyed; consequently the compartments intact have to restore this loss, which is done by the vessel being immersed to a volume equal to that of the flooded portion, this being divided over them.

Then to ascertain the sinkage of vessel under this condition we have: S = sinkage of vessel in feet. V = volume of damaged portion. A = area of intact water plane.

Then $S = \frac{V}{A}$. The total volume of displacement when vessel is intact is :—$400 \times 40 \times 17 = 272{,}000$ cubic ft. After damage $280 \times 40 \times 17 = 190{,}400$ cubic ft. ∴ loss of buoyancy $= 272{,}000 - 190{,}400 = 81{,}600$ cubic ft., whence vessel will sink to a depth—

$$S = \frac{V}{A} = \frac{81600}{280 \times 40} = 7\frac{2}{7}\text{ft.}$$

Wherefore the bulkheads must extend more than $7\frac{2}{7}$ feet above the water-line to qualify the vessel for the first grade referred to above. This will be necessary, as the tops would be reached when the vessel was rolling. But in (*b*), supposing a watertight deck was worked 2ft. below the waterline, as indicated by the dotted line *c c*, then the sinkage would be equal to the volume of the space below this deck only. Therefore, the volume of the damaged portion $= 120 \times 15 \times 40 = 72{,}000$ cubic ft. In this case the water plane is intact, therefore we have for

$$S = \frac{V}{A} = \frac{72{,}000}{400 \times 40} = 4\tfrac{1}{2}\text{ft.}$$

Thus it will be observed that the sinkage will be about $\frac{5}{8}$ths that of (*a*).

Next taking (*c*) Fig. 2, and assuming one side to be bilged only, the sinkage would be reduced to one-half that of (*a*), but the vessel would have a list towards the side where the damage was located, thereby to a large extent probably endangering the vessel's safety; but in (*d*) Fig. 2, with valves in longitudinal bulkheads to equalise the water, the conditions would be as in (*b*). The longitudinal bulkhead would localise the water, and the pumps be enabled to keep the water under until leak stoppers could be applied.

In (*e*) Fig. 3, with the cellular or double bottom, the protection against accident is two-fold, and the damage confined to the cellular bottom.

Now supposing the bottom to be 4ft. deep throughout, and the two spaces became damaged in a similar position as in (*a*), the volume of the damaged portion would be $120 \times 40 \times 4 = 19{,}200$ cubic ft., and

$$S = \frac{V}{A} = \frac{19{,}200}{400 \times 40} = 1\tfrac{1}{5}\text{ft.},$$

or nearly $\frac{1}{3}$ that of (*a*) or $\frac{4}{15}$ of (*b*), thus illustrating the value of such. There are other qualifications as to the value of cellular bottoms, consisting of trimming facilities, water ballast, etc., but such do not come within the province of our article.

The last condition, (*f*) Fig. 5, is that which may be considered as unsafe.

In this case, assume the bulkheads to be spaced as follows, reckoning from forward, 20, 30, 50, 100, 90, 60, 30, 20ft., and run up to a deck (not watertight) 6ft. above the water-line; let the central compartments A A be bilged as in (*a*). It will then be seen that the water entering will fill the two compartments, and afterwards flow over the tops into those adjacent; the same will occur in the next, and so on until the vessel founders.

(To be continued.)

MEM. FOR ADVERTISERS.—The charges for advertisements in THE MECHANICAL WORLD are less than half those of any other engineering journal in proportion to circulation, and not one-eighth the price of some of its competitors.

Sugar-making Machinery.-XVII.

[ALL RIGHTS RESERVED.]

THE cattle mills are made in sizes ranging from 8in. by 10in. to 18in. by 30in. long. The following table gives a list of the sizes most commonly made of this class of mill, with their capacities, etc. :—

TABLE VIII.—SUGAR MILL WITH CATTLE GEAR.

Canes Crushed per Hour in Cwt.	No. of Cattle Required	Diameter of Rollers in In.	Length of Roller in In.	Approx. Weight in Cwt.	Weight of Sugar per Day of 10 Hours Approx.
					Cwt.
3	1	8	10	21	4
4½	2	9	12	26	6
6½	2	10	14	32	8
14	3	12	18	53	15
20	3	14	21	94	20
36	4	16	24	122	30
50	6	18	30	186	40

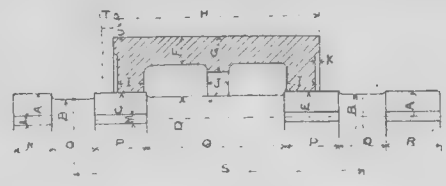


FIG. 32.

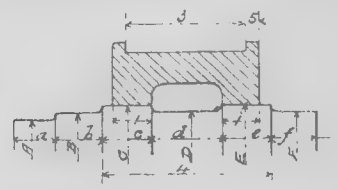


FIG. 33.

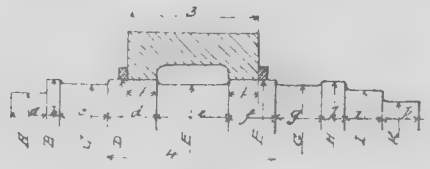


FIG 34.

TABLE IX.—DIMENSIONS OF ROLLERS FOR CATTLE MILLS.

Size of Rollers.			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	Dia. of Vertical Spindle.
Dia. in In.	Length in In.																							
8	10	Top	2¼	2½	2⅝	2½	2 13/16	1¼	—	10	2	—	—	½	½	4½	4½	3½	6	5	16⅜	—	—	3
		Side	2½	2½	2⅝	2½	2 13/16	1⅛	—	10¼	2	—	—	½	½	4½	4½	3½	6	5	16⅜	1 1/16	9/16	
9	12	Top	2½	2½	3 1/16	2½	3	1½	—	12	2½	—	—	⅝	⅝	5	4½	3⅝	8	5½	20½	—	—	3½
		Side	2½	2½	3 1/16	2½	3	1½	—	12½	2½	—	—	⅝	⅝	5	4½	3⅝	8	5½	20½	⅝	⅝	
10	14	Top	2½	2⅝	3 5/16	2⅝	3¼	1½	—	14	2½	—	—	¾	¾	5½	4⅝	4	10	6	22⅝	—	—	3½
		Side	2½	2½	3 1/16	2½	3	1½	—	14½	2½	—	—	¾	¾	5½	4⅝	4	10	6	22⅝	⅞	¾	
12	18	Top	2⅞	3¼	4⅞	4	4⅛	1⅝	—	18	3¼	—	—	⅞	⅞	8	5	6½	8	6	26½	—	—	4½
		Side	2⅞	3¼	4½	3½	4 1/16	1⅝	—	18½	4½	—	—	⅞	⅞	5	5½	7	7½	6	—	1⅛	⅞	
14	21	Top	3½	4½	5 5/16	4½	5⅝	1⅞	—	21	5	—	—	1½	1½	4½	6	5⅝	12½	7½	29½	—	—	4⅝
		Side	3	4	4 11/16	4½	5	1⅞	—	21⅓	5	—	—	1½	1½	5	6¼	5⅝	12½	7½	29½	1⅛	⅞	
16	24	Top	5⅞	5	6	5	5 1/16	2	2½	24	5	2	⅜	1⅝	1½	8⅜	6½	7⅝	13½	10	35	—	—	4⅞
		Side	5⅜	4½	5¼	4½	5 1/16	2	2½	24½	5	2	1⅛	1⅝	1½	8⅜	6½	7⅝	13½	6½	35	1⅜	⅞	
18	30	Top	6⅞	6	7	6	6 1/16	2½	2⅝	30	5½	2	⅜	1⅝	1½	8⅜	7¼	8⅜	18	10	42	—	—	5
		Side	6⅜	5½	6½	5½	6 1/16	2	2½	30½	5½	2	1⅝	1⅜	1¼	8⅜	7¼	8⅜	18	7½	42	1½	1	

TABLE X.—TOP ROLLERS AND GUDGEONS.

MILL.	A	B	C	D	E	F	G	H	I	K	*a*	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*k*	1	3	4
12in. × 18in.	—	4⅜	3¾	4⅞	4	4½	3¾	4⅜	pinion end.		8	½	5	7	7½	7	5	5½	pinion.		4	18	21½
14in. × 21in.	2½	5¼	4¼	5 1/16	4½	5⅝	4¼	5¼	4¼	3¼	4½	1	6	8	8	8	6	7	13½	6½	5	21	24
16in. × 24in.	3	6	5	6 1/16	5	5⅝	5	6	5	3½	5	1	6½	9	9½	9	6½	7½	15½	7½	—	24	27½
18in. × 26in.	3½	6 1/16	6	6 1/16	6	7	6	7	6	4½	6	1	7	9	12	9	7	8	17½	7⅞	—	26	30

TABLE XI.—SIDE ROLLERS AND GUDGEONS.

MILL.	A	B	C	D	E	F	*a*	*b*	*c*	*d*	*e*	*f*	1	3	4	5
12in. × 18in.	—	3½	4½	3½	4 3/16	3½	—	5½	7	7½	7	10½	4½	18½	—	1⅜
14in. × 21in.	2⅜	4	4 1/16	4½	5	4	5	6½	8	8	8	13	5	21½	24	1½
16in. × 24in.	3	4½	5¼	4⅜	5 7/16	4½	5½	7	9	9	9	13½	—	24½	—	1½
18in. × 26in.	3½	5½	6 7/16	5½	6½	5½	6	8	9	12	9	15½	—	26½	—	1¼

One make of rollers for this class of mill is illustrated in Fig. 32, and Table IX. gives the leading dimensions for the various sizes.

Figs. 33 and 34, with Tables X. and XI., give the main dimensions of a similar set of mills for small combined plants of rather heavier make.

(To be continued.)

The British Association.

ADDRESS TO THE MECHANICAL SCIENCE SECTION.*

BY what process selection is made of a sectional president of the British Association is to me unknown. I may confess that it was pleasant to receive the request of the Council to preside at the meetings of Section G, even though much of the pleasure was due to its unexpectedness. I ventured to believe I might accept the honour gratefully, trusting to your kindness to assist me in fulfilling its obligations. Amongst engineers there are many with greater claims than I have to such a position, and who could speak to you from a wider practical experience. Here, in Section G, I think it may be claimed that the profession of engineering owes much to some who from circumstances or natural bias have concerned themselves more with those scientific studies and experimental researches which are useful to the engineer than with the actual carrying on of engineering operations. Here, at so short a

* By W. Cawthorne Unwin, F.R.S., M.I.C.E., President of the Section.

distance from the university where Rankine and James Thomson laboured, I may venture to feel proud of being amongst those whose business it has been rather to investigate problems than to execute works.

The year just passed is not one unmemorable in the annals of engineering. By an effort remarkable for its rapidity, and as an example of organisation of labour, the broad-gauge system has been extinguished. It has disappeared like some prehistoric mammoth, a large-limbed organism perfect for its purpose, and created in a generous mood, but conquered in the struggle for existence by smaller but more active rivals. If we recognise that the great controversy of 50 years ago has at last been decided against Brunel, at least we ought to remember that the broad-gauge system was one only of many original experiments due to his genius and courage—experiments in every field of engineering, in bridge building, in locomotive design, in ship construction—the successes and failures of which have alike enlarged the knowledge of engineers and helped the progress of engineering. The past year has seen the completion of the magnificent scheme of water supply for Liverpool from the Vyrnwy, carried out from 1879 to 1885 by Mr. Hawksley and Mr. Deacon, and since then completed under the direction of the latter engineer. This is one of the largest and most striking of those works of municipal engineering rendered necessary by the growth of great city communities, and made possible by their wealth and public spirit. For the supply of water to Liverpool, the largest artificial lake in Europe has been created in mid-Wales by the construction across a mountain valley of a dam of cyclopean masonry, itself one of the most remarkable masonry works in the world. The lake contains an available supply of over 12,000 million gallons, its size having been determined not only to supply 40 million gallons daily for the increasing demand of Liverpool, but also to meet the necessity imposed by Parliament, that an unprecedentedly large compensation, amounting to ten million gallons daily and 50 million gallons additional on 32 days yearly, should be afforded to the Severn. The masonry dam, though a little less in height than some of the French dams, is of greater length. It is nearly double the length of the great dam at Verviers.* Although masonry dams were an old expedient of engineers, it is in quite recent times, and chiefly in consequence of the scientific investigations of French engineers, that they have been revived in engineering practice. Since the construction of the Vyrnwy dam, another very large dam, the Tansa dam, has been completed in Bombay. This dam has a length of two miles and a height of 118ft., and it is 100ft. thick at the base. The reservoir will supply 100 million gallons per day. In the United States a still greater work of the same kind has been commenced on the Croton river, in connection with the water supply of New York. This dam will have a length of 2000ft. and a height of 285ft. Its greatest thickness will be 215ft. It will be very much the boldest work of its kind. Returning to the Liverpool supply, the water taken from the lake at the most suitable level into a straining tower provided with very complete hydraulic machinery, passes through the Hirnant tunnel, and thence by an aqueduct, partly consisting of rock tunnels, partly of pipes 39in. to 42in. in diameter, 68 miles in length, being the longest aqueduct yet constructed. The crossing of the Mersey by an aqueduct tunnel has proved the greatest engineering difficulty to be surmounted. The tunnel has been carried through layers of running sand, gravel, and silt. At first slow progress was made, but later, by the adoption of the Greathead system of shield, with air locks and air-compressing machinery, as much as 57ft. of tunnel were driven and lined in one week. The whole work is now complete, and Liverpool has available an extra supply of very pure water, amounting to 40 million gallons daily. A scheme of water supply for Manchester from Lake Thirlmere, in Westmorland, on an equally large scale, is approaching completion. Birmingham is likely to carry out another work of the same kind, and London, at a greater distance from pure water sources, and under greater difficulties from the complexity of existing interests, has come to realise that, within fifty years, a population of 12½ millions will probably have to be provided for. To supply such a population, a volume of water is required ten times as great as the whole available supply from Lake Vyrnwy.

* The length of the dam from rock to rock is 1172ft. Height from lowest part of foundation to parapet of carriage-way 161ft. Height from bed of river to overflow sill, 84ft. Thickness of masonry at base, 120ft.

Here in Edinburgh one remembers that the birthplace of the steam engine is near at hand. A century and a quarter ago, James Watt made an invention which has profoundly influenced all the conditions of social, national, commercial, and industrial life. It is due to the steam engine more than to any other single cause that the population of this country has tripled since the beginning of the century, and that we have become dependent on steam power for fuel, for transport, for manufactures, in many cases for water supply, for sanitation, and for artificial light. From some German statistics it appears that there are probably now in the world employed in industry, steam engines exerting 49 million horse-power, besides locomotives exerting six million horse-power. Engines in steamships are not included. The steam engine has become a potent factor in civilisation, because it places at our disposal mechanical energy at a sufficiently low cost, and the efforts of engineers have been steadily directed to diminishing the cost at which steam power is produced. Members of one great branch of our profession are much concerned in the production of mechanical energy at a sufficiently cheap rate. They require it in very large quantity for retransformation into mechanical energy under conditions more convenient than the direct use of steam power. Perhaps it will not be inappropriate if in Section G I first discuss briefly some of the causes which have made the steam engine inefficient, and the extent to which we are getting to a scientific knowledge of the methods of evading them. I propose then to consider some of the methods of economising the cost and increasing the convenience of mechanical power by generating it at central stations and distributing it, and, lastly, how far means of transporting energy are likely to make available cheaper sources of energy than steam power. Let us go back for a moment to James Watt. The most distinct feature about the invention of the steam engine is that it arose out of studies of such questions as the relation of pressure and temperature of steam, the heat absorbed in producing it, and its volume at different pressures. Armed with this knowledge Watt was able to determine that the quantity of steam used in a model atmospheric engine was enormously greater than that due to the volume described by the piston. There was waste or loss. To discover the loss was to get on the path of finding a remedy. The separate condenser, by diminishing cylinder condensation, annulled a great part of the loss. So great was Watt's insight into the action of the engine that he was able to leave it so perfect that, except in one respect, little remained for succeeding engine builders, except to perfect the machines for its manufacture, to improve its details, and to adapt it to new purposes. Now it very early became clear that there were two directions of advance which ought to secure greater economy. Simple mechanical indications showed that increased expansion ought to ensure increased economy. Thermodynamic considerations indicated that higher pressures, involving a greater temperature range of working, ought to secure greater economy. But in attempting to advance in either of these directions, engineers were more or less disappointed. Some of Watt's engines worked with 5lb. of coal per indicated horse-power per hour. Many engines with greater pressures and longer expansions have done but little better. The history of steam-engine improvement for a quarter of a century has been an attempt to secure the advantages of high pressures and high ratios of expansion. The difficulty to be overcome has proved to be due to the same cause as the inefficiency of Watt's model engine. The separate condenser diminished, but it did not annul the action of the cylinder wall. The first experiments which really startled thoughtful steam engineers were those made by Mr. Isherwood between 1860 and 1865. Mr. Isherwood showed that in engines such as those then in use in the United States Navy, with the large cylinders and low speeds then prevalent, any expansion of the steam beyond three times led, not to an increased economy, but to an increased consumption of steam. Very little later than this M. Hirn undertook, in 1871-5, his classical researches on the action of steam in an engine of about 150I.H.P. Experiments of greater accuracy or completeness, or of greater insight into the conditions which were important, have never since been made, and Hirn, with his assistants, MM. Hallaner and Dwelshauvers Dery, has determined, once for all, the whole method of a perfect steam-engine trial. M. Hirn was the first to clearly realise that the indicator gives the means of determining the steam present in the cylinder during every period of the cycle of the engine. Consequently, superheating in ordinary cases being out of the question, we have the means of determining the heat present and the heat already converted into work. The heat delivered into the engine is known from boiler measurements, combined with calometric tests of the quality of the steam, tests which Hirn was the first to undertake. The balance or heat unaccounted for is, then, a waste or loss due to causes which have to be investigated. Hirn originated a complete method of analysis of an engine test, showing at every stage of the operation the heat accounted for and a balance of heat unaccounted for; and the latter proved to be a very considerable quantity. Meanwhile theoretical writers, especially Rankine and Clausius, had been perfecting a thermo-dynamic theory of the steam engine, based primarily on the remarkable and irrefragable principle of Carnot. The result of Hirn's analysis was to show that these theories, applied to the actual steam engine, were liable to lead to errors of 50 or 60 per cent., the single false assumption being made that the interaction between the walls of the cylinder and the steam was an action small enough to be negligible.

(To be continued.)

Description of the Lifting and Hauling Appliances in Portsmouth Dockyard.†

In addition to the hand-power appliances which are common to all such large establishments, there are in use in Portsmouth Dockyard, for the cranes, capstans, etc., three separate systems of mechanical power—viz., steam, hydraulic, and pneumatic. The first of these, besides being employed for working several machines direct, is also used for producing the pressures required for the two other systems. There are in the dockyard, in almost constant use for various purposes, no less than 96 boilers, with an aggregate of 784 sq. ft. of grate surface, burning about 10,000 tons of coal per annum, and developing an average of 3150I.H.P. during working hours. Most of them are fitted with feed-water heaters, by which some of the waste heat from uptakes is utilised, and the feed-water is supplied to the boilers at a temperature of about 130°F. The majority of the boilers are worked at pressures of from 60lb. to 80lb. per sq. in.

Hydraulic Power. — There are three separate pumping stations for obtaining the pressure for the general service of the yard—that is to say, for the ordinary cranes, capstans, etc. The pipes are connected, so that any of the pumps can be used on the system. Water here being cheap, there are no return pipes, but the exhaust water runs away into the drains.

The first hydraulic pumping station is near the main entrance to the yard, and includes two separate sets of engines, each with a pair of pumps. The larger set has cylinders 26¾in. and 38in. diameter with 2ft. stroke, the diameter of the pump plungers being 5⅞in., and the indicated horse-power of the set is 128. The smaller set of engines is of about 40H.P., and is used chiefly as a stand-by. It is seldom required to keep more than one of the two sets of engines running for working all the hydraulic machines in connection with this station. These comprise eight cranes, with lifting powers varying from 1½ to 10 tons, nine capstans, and nine lifts. The engines also supply pressure for working the chain-cable testing machines, as well as water for testing boiler and other tubes.

The second hydraulic pumping station is at the iron foundry, where there are two sets of pumps worked from the shop shafting. These are primarily for the use of the foundry, in which there are three lifts; but being connected with the main pressure service pipes, the pumps can be used for the general service of the dockyard if necessary.

The third hydraulic pumping station is at the head of No. 8 dock, and the engine here is more modern than either of the others; it is compound, and capable of developing about 112I.H.P.

The total length of pressure pipes is about 10,000ft., or nearly two miles. The pipes vary from 1¼in. to 4in. diameter, and are placed entirely underground. There is therefore no serious trouble from frost during cold weather; all that is found necessary is to light small gas jets in the various engine-boxes at the cranes and capstans.

In addition to this main hydraulic system, there are certain complete self-contained local systems. In the smithy is placed one of these, comprising a 20H.P. steam engine and accumulator, working two 40-ton cranes with travellers. In the boiler-shop there is another set of hydraulic plant for working the riveters, hydraulic presses, etc. Another application of hydraulic power is for stretching boiler tubes, and a machine for this purpose is now at work in the boiler-shop. A commencement was made by stretching brass tubes which had been removed from boilers for cleaning; new good ends were thus obtained for fitting in tube plates. After having been extended to iron tubes, the practice has now been further extended to steel tubes, which above a certain limited size—say 2½in. diameter—require heating before being stretched. Tube-stretching machines with hydraulic jacks have since been supplied to all the foreign dockyards of H.M. Government, so that tubes of boilers which have been removed for cleaning can now be stretched and put back again, instead of new tubes having to be used, as formerly.

An additional complete hydraulic system with boilers and engines is now being fitted at Coaling Point by Messrs. Tannett, Walker and Co. It is intended for coaling the fleet either direct from the shore or by means of lighters; and, besides ten 30cwt. travelling cranes, it will comprise three 10-ton coal tips, with the necessary capstans, weighbridges, etc. This hydraulic system is fitted with return water pipes.

Compressed Air.—In the most modern part of the dockyard the lifting and hauling appliances are worked chiefly by compressed air; the only exceptions are the heavy cranes and shears, which are worked by steam-power direct. The air is compressed to 60lb. pressure per sq. in. into eight wrought-iron receivers, having a total capacity of 18,000 cubic ft. The compressing is done by one or other of two separate sets of pumps. One set consists of two pairs of compressing pumps worked through gearing, either separately or together, by a pair of simple engines of 90I.H.P. The other set of pumps is worked by a pair of compound beam engines of 200I.H.P. This machinery is situated at the main pumping station about the centre of the yard; and besides the air-compressing machinery the same building contains the main dry-dock pumping machinery of 1000I.H.P., and two pairs of 120H.P. engines for general fire and dock-drainage purposes. The larger set of air-compressing pumps will fill the eight reservoirs to 60lb. pressure in one hour. No case of a receiver bursting has occurred here, and there is no record of a pipe having been replaced during the last two years. There is also less trouble with air joints than with steam and hydraulic joints.

The air pipes, which have a total length of 14,000ft., or about 2⅔ miles, and vary from 3in. to 12in. diameter, extend round the large basins, and are connected to forty 7-ton capstans, to five 20-ton cranes, and to the machinery for working seven caissons and numerous penstocks, besides driving a small workshop engine. The air pressure is also used occasionally for driving small engines for carrying out machine-work on board ships building; and it has also been connected with the auxiliary steam pipes of some of the larger battleships, so that air-pressure could be used instead of steam for driving the hydraulic pumping engines on board the ships for working the gun gear for drill purposes, and also for driving the electric-light engines and other auxiliary machinery on board. This obviates the necessity of getting up steam in the ships' boilers, thus admitting of their being kept systematically in a certain condition—either closed and dry, or quite full of water; which would be impracticable if they were being used at irregular intervals and at short notice.

† Paper by Mr. John T. Corner, R.N., Chief Engineer, read before the Institution of Mechanical Engineers.

The Belfast Mechanical and Engineering Association.

On Friday, the 5th inst., the members of this association, by the kind permission of James Musgrave, Esq., J.P., chairman of the Belfast Harbour Commissioners, paid a visit to No. 4 hopper dredger. They were met at the harbour offices by Mr. E. Macillwaine, who has charge of the machinery belonging to the Commissioners, and found the s.s. "Lion" awaiting to convey them down the Channel to the place where the dredger was at work.

On board the dredger they were received by Captain Smiley and the first engineer, Mr. Garrett, who did all in their power to make the visit both pleasant and profitable to the visitors. The party now split up into sections, being conducted by Messrs. Macillwaine, Smiley, and Garrett. They inspected the engines, powerful

machinery, and electric-lighting apparatus, seeing the various parts both at rest and in motion, also having many inquiries answered by the above-named gentlemen.

At the conclusion of the inspection a few of the members remained on board the dredger, to proceed with it when loaded to sea, the remainder of the party returning to the quay on board the s.s. "Lion." Before parting, the members, through their president, thanked the various gentlemen who had so kindly assisted in making the visit a success. After landing it was found that the large swing bridge leading to one of the docks was open, and the closing of it afforded an opportunity to examine the machinery at work.

Metal Trade Memoranda.

The output of ore from the Marbella Iron Ore Company's mines for the month of July was 5325 tons.

The American copper market has been lately depressed, in order, it is alleged, to buy the stock of the French Syndicate.

The export of gold from Cape Colony during the month of July amounted in value to £381,000, against £260,000 last year.

Mr. Edwards, the proprietor of the Morriston Tinplate Works, has commenced the manufacture of tinplates at works situated near Philadelphia.

The stocks of copper in England and France increased during July by 3134 tons to 59,738 tons. The supplies amounted to 11,633 tons, and the deliveries to 8499 tons.

The steamship "Port Albert" arrived at Glasgow recently from New Caledonia with 4500 tons of nickel ore on board. This is said to be the largest cargo of nickel ore yet received in this country.

Nickel or copper-nickel plating on iron can be removed by heating the iron in crucibles to a red heat, adding sulphur, and again bringing to a red heat, the crucible being closed, The sulphides of nickel or copper so produced are brittle and can be separated from the iron by hammering.

The production of American tinplates for the quarter ending June 30, 1892, was over 8,000,000lb., as compared with 3,000,000 during the previous quarter, and about 5,240,000lb. in the previous nine months, the total output for the year being 13,240,830lb. Of the 8,000,000lb. produced during the last quarter, over 5,000,000lb. were made from American block plates.

The whole of the enginemen, stokers, and mechanics employed by the Ebbw Vale Iron and Steel Company have given notice to terminate their contracts at the end of this month. The sliding scale for the regulation of iron and steel workers' wages comes to an end on the 31st inst., and the object of the Ebbw Vale men in giving notice is to endeavour to secure an advance in wages.

Sir John Jenkins, presiding at the annual meeting of the Swansea Metal Exchange the other day, stated that in the tinplate trade they were threatened with competition from one of their largest customers, America, where some manufacturers had already commenced operations. But he believed that the tinplate makers in this country would be able to hold their own not only in America, but throughout the world.

For the first time, ingot steel was manufactured in India on June 28. It was produced at the Government gun factory at Cossipore, a suburb on the north of Calcutta. The experiment was undertaken in pursuance of a Government resolution that in future all steel projectiles and ordnance fittings intended for use in India should be made in the dependency. The plant employed at Cossipore is of the most modern kind, and consists of a furnace, four gas producers, a few annealing ovens, and other appliances. The steel is melted not by means of coal, but by the radiation of gas furnished by the producers, and the rate of production is from four to five tons per hour. The annealing ovens are also heated with gas. The steel produced at the first trial of the new works is described as of good quality.

The Metal Market.

PRICES CURRENT.

LONDON, Aug. 8.

COPPER this morning opened easy at 2s. 6d. decline, and although the market improved a shade, the dull tone caused a relapse to inital values, at which the close was steady. Sharp cash made £44 12s. 6d.; later August dates, £44 15s. and £44 13s. 9d.; and three months, £45 2s. 6d. Sales, 250 tons. Settlement price, £44 12s. 6d. English tough, £47; best selected, £48; strong sheets, £56 10s.

TIN opened weak, with three months 12s. 6d. down, and quickly dropped another 10s., owing to the depressed state of the silver market, heavy shipments to date, and the withdrawal of recent prominent support. The poor demand induced further liquidations, and the close is weak, cash being 30s. and three months 27s. 6d. under Friday's values. Three months was done at £95, £94 10s., and £94 5s., while late August sold at £94 17s. 6d. to £94 15s., and cash in a few days at £94 15s. Sales, 70 tons. Settlement price, £94 15s. English ingots, £98,

PIG IRON has been inactive. During early trading there were cash buyers at 41s. 10½d., but in the afternoon only 41s. 9d. was bid, and official rates mark a loss of 1½d. for Scotch since Friday, while Middlesbrough was unaltered, but hematite 6d. down. Settlement prices:—Scotch, 41s. 9d.; Middlesbrough, 38s. 9d.; hematite, 49s.

TINPLATES steady. I.C. cokes, f.o.b. London, 13s.; Liverpool, 12s. 6d.; Swansea, 12s. 3d.

LEAD remains quiet and unchanged, with Spanish offering at £10 8s. 9d.; English, £10 12s. 6d. to £10 15s.

SPELTER ruled dull, and closed about 2s. 6d. lower, August shipment, £21 7s. 6d. Silesian specials, £22.

ZINC.—Silesian sheets slow of sale at decline of 2s. 6d. Ordinary ex ship, £23 15s., sellers. Belgian quiet. V.M. brands, ex ship, £24; export, £23 15s., sellers.

OFFICIAL CLOSING QUOTATIONS.

	£	s.	d.	£	s.	d.
COPPER—						
G. M. B.—Cash	44	12	6	45	0	0
„ Three months	45	2	6	45	10	0
English tough	—			—		
Best selected	—			—		
Strong sheets	—			—		
TIN—						
Fine foreign, cash	94	15	0	95	5	0
„ three months	94	5	0	94	15	0
Australian, cash	95	5	0	95	15	0
PIG IRON—				s.	d.	
Scotch warrants—Cash				41	9½	
„ One month				42	0	
Middlesbrough—Cash				38	9	
„ One month				—		
Hematite—Cash				49	0	
„ One month				—		

GLASGOW, Aug. 8.—The pig iron market was quiet and rather flat in tone. Dealing was again confined to Scotch, not more than 10,000 tons of which changed hands, and on the day the cash price fell 2d. A lot was also done at 42s. cash in four weeks. The sellers' price of Cleveland, which is purely nominal, was raised 4d., but hematite remains unchanged. The shipments of Scotch last week were 7005 tons, a decrease of 25 tons against the same week last year. For the year to date the shipments show an increase of 37,410 tons against the same period last year.

QUOTATIONS.

	Highest.		Lowest.	
	s.	d.	s.	d.
Scotch warrants—Cash	41	11	41	9½
„ One month	42	1½	42	0
Middlesbrough—Cash	38	9	38	9
„ One month	—		—	
Hematite—Cash	49	0	49	0
„ One month	—		—	

Official Gazette.

Partnerships Dissolved.

S. H. FARRAR, G. H. FARRAR, and J. P. FARRAR, under the style of Howard Farrar and Co., Cornhill, City, Johannesburg, Port Elizabeth, and East London, engineers and merchants.

W. E. WILLIAMS, D. M. DAVIES, J. T. GREEN, and C. ASHWIN, under the style of the Viaduct Foundry and Engineering Company, Crumlin, Monmouthshire, foundrymen, engineers, and wagon builders; as far as regards D. M. Davies.

M. KITSON and W. H. KITSON, under the style of the Leeds Wheel and Axle Company, Leeds, wheel and axle makers.

DOWDING and ATKINS, Birmingham, metal dealers and refiners.

THE BANKRUPTCY ACTS, 1883 AND 1890.

Receiving Order.

ROBERT OWEN PARRY, Chester, ironfounder.

Adjudications.

WALTER PHILIP O'REILLY, Edgware-road, W., late Old Broad-street, City, manufacturing electrician.

ROBERT OWEN PARRY, Chester, ironfounder.

Commercial Gazette.

☞ The name given is that of the defendant; the amount is that for which judgment was given, and the date is that on which it was given.

County Court Judgments.

SMITH, GAVIN AND CO., East Side, Tyne Docks, South Shields, engineers. £11 3s. 11th July.

THE AUTOMATIC AERATION COMPANY LIMITED, Newport-street, Charing Cross-road, engineers, £11 7s. 6d. 12th July.

New Companies.

ONCKEN PATENT STAVELESS BARREL CO. LIMITED.—This company was registered on the 30th ult., with a capital of £150,000, in £2 shares (of which 50,000 are ordinary and 25,000 deferred), to enter into and carry into effect an agreement to be made between Woodhouse and Rawson United Limited of the first part, Mr. G. A. Oncken of the second part, the Merxem Works Limited of the third part, and this company of the fourth part, and to carry on the manufacture and sale of staveless barrels, boxes, panels, veneers, and other articles made from or connected with the manufacture of wood or machinery for the same, the business of contractors for the sale, letting on hire, erection and maintenance of the said machinery, and also that of electrically and chemically treating wood and other substances. The number of directors is not to be less than three nor more than nine; qualification, £250; remuneration, chairman, £300 per annum; ordinary directors, £150 per annum each and 10 per cent. of the surplus profits after the payment of 12 per cent. on the ordinary and deferred shares. Registered by Messrs. Budd, Johnson and Jecks, solicitors, 24, Austin Friars, E.C.

SLAG REDUCTION COMPANY LIMITED.—This company was registered on the 29th ult., with a capital of £50,000, in £10 shares, to enter into an agreement with Messrs. F. Nettlefold, A. G. Renshaw, and A. H. Renshaw, for the sale to the company of certain patent and other rights for the use of attrition mills and magnetic separators, together with certain plant, machinery, and premises; to enter into the contracts referred to in clause 3 of the articles (with Messrs. Steel, Peech and Tozer Limited and with Nettlefolds Limited), and to carry on the business of grinders and reducers of materials, manufacturers of iron, steel, coke, cement, manure, paint, bricks, and chemicals, smelters, engineers, founders, etc. The number of directors is not to be less than three nor more than seven, the first to be nominated at the first general meeting; qualification, 50 shares; remuneration to be fixed by the company in general meeting. Registered by Messrs. Renshaw, Kekewich and Co., solicitors, 2, Suffolk-lane, E.C.

DAY'S GAS ENGINE COMPANY LIMITED.—This company was registered on the 29th ult., with a capital of £60,000, in £5 shares, to enter into and carry into effect an agreement dated July 11, 1892 (the parties of which are not mentioned), for the acquisition of the English and foreign patents granted or to be granted to Mr. J. Day for improvements in gas engines, etc., and to manufacture and grant licences to manufacture gas engines under the said patents. The number of directors is not to be less than three nor more than seven, the first being Messrs. B. H. van Tromp, E. Garcke, C. H. Fox, H. Wethered, and E. Broderip; qualification, £250; remuneration, £600 per annum and 10 per cent. of the surplus profits after the payment of 7 per cent. on the preference shares. Registered by Mr. H. C. Godfray, solicitor, 60, Finsbury Pavement, E.C.

RICHARDSON, CHILD, CHRISTY AND CO. LIMITED.—This company was registered on the 29th ult., with a capital of £33,800, in £10 shares, to acquire, take over as a going concern, and carry on the business of steel pin manufacturers, carried on by a company of the same name (now in liquidation), at Horsforth, Leeds. The number of directors is not to be less than five nor more than seven, the first being Messrs. J. J. Richardson and T. Sayer and four others to be appointed at the first general meeting; qualification, £500; remuneration, £50 each per annum; Messrs. J. J. Richardson and T. Sayer are managing directors for five years, with a salary of £500 each per annum for the first three years, and £300 each per annum after. Registered by Messrs. Vincent and Vincent, 20, Budge Row, E.C.

BREAGE TIN MINE LIMITED.—This company was registered on the 2nd inst., with a capital of £6000, in £1 shares, to adopt and carry into effect an agreement dated July 22, 1892, between Mr. W. C. Venning of the one part, and Mr. T. B. Powis (for the company) of the other part, and to carry on the business of winning and working tin and other ores, metals, and minerals. The number of directors is not to be less than three nor more than six, the first being Messrs. G. Dalton, J. R. Brough, T. Sopwith, C. H. C. Huddart, and J. E. Venning; qualification, £150; remuneration, £75 each per annum, with an extra £25 per annum for the chairman. Registered by Messrs. Venning, Sons and Mannings, solicitors, 80, Gresham House, E.C.

Letters to the Editor.

*** *We do not hold ourselves responsible for opinions expressed by correspondents.*

*** *The name and address of the writer (not necessarily for publication) must in all cases accompany letters intended for insertion, or containing queries.*

*** *Letters intended for publication in the current week's issue must reach our Manchester Office not later than by the first post on the Tuesday preceding the date of publication.*

FEED-WATER HEATERS.

To the Editor of THE MECHANICAL WORLD.

SIR,—In your issue of July 29 I noticed a reply to a correspondent concerning the amount of heating surface usually allowed by first-class makers of feed-water heaters. It occurred to me that there must be some mistake in the rule given—viz., $1{\cdot}25E^2$—which, for a 6in. feed-water heater, would only give 45 sq. ft. I have seen some heaters apart, and they certainly gave me the impression that there was considerably more heating surface than this rule gives. Perhaps some of your numerous readers would kindly state their experience on this point. E. J. B.

Handsworth, Aug. 8.

THE ROYAL MANCHESTER AND LIVERPOOL SHOW.

To the Editor of THE MECHANICAL WORLD.

SIR,—Will you kindly permit me, through the medium of your valuable paper, and in the interest of manufacturers in general, to ask the judges who awarded the prizes at the Royal Manchester and Liverpool Show, held at Newsham Park, Liverpool, whether they have any objection to publishing the indicator diagrams and notes taken in reference to Class 282 in competition for the prize gold medal awarded for the best steam, gas, or other engine for agricultural purposes? The competitors were: The Vulcan Ironworks Company—a 5 tandem compound portable engine; Ransome and Marshall, Liverpool—simple engine; Day and Co., Bath—gas engine. The principal judge was Mr. W. King, M. Inst. C.E., Duke-street, Liverpool.

Aug. 3. TANDEM COMPOUND.

CONICAL TANK.

To the Editor of THE MECHANICAL WORLD.

SIR,—I am surprised that so simple a question should give rise to such a lot of correspondence.

I am astonished at Mr. Wm. Cox's remarks—namely, that his solution is simpler than mine. It is evident that your correspondent is not quite familiar with the treatment of these simple questions. In your issue for July 8 I gave a general formula for the solution of all cases of this nature, whereas Mr. Cox's method—if it can be called so—is no solution at all. As pointed out by "H. St.," the equation, $K = D^2 + d^2 + Dd$, wherein K alone is known, is susceptible of an infinity of solutions. In your issue for August 5 Mr. Cox completes the solution of the query by solving this quadratic equation in a roundabout way—a trouble which he might well have spared himself had he dealt with the problem as "H. St." and myself have done.

It will be seen that any formula gives the result required, whatever the ratio of the two diameters may be, provided it exceeds unity. E. GOBERT.

South Tottenham, Aug. 7.

Prize Competition.

WE OFFER FOUR GUINEAS MONTHLY IN PRIZES FOR THE BEST ORIGINAL ARTICLES SENT IN ON ANY MECHANICAL, ENGINEERING OR ELECTRICAL SUBJECT.

IN ORDER THAT MANAGERS, DRAUGHTSMEN, FOREMEN, AND WORKMEN WHO HAVE HAD NO PRACTICE IN WRITING MAY NOT HESITATE TO SEND IN COMPETITIONS, IT IS TO BE UNDERSTOOD THAT ALL ARTICLES WILL BE FULLY EDITED AND CORRECTED, AND JUDGED OF SOLELY ON THEIR MERITS AS ORIGINAL CONTRIBUTIONS FROM A PRACTICAL POINT OF VIEW. THE OBJECT OF THE COMPETITION IS TO INDUCE PRACTICAL MEN TO COME FORWARD AND GIVE THE RESULTS OF THEIR EXPERIENCE.

CONDITIONS.

Competitions for our Monthly Prizes must be sent so as to arrive at the Manchester Offices of THE MECHANICAL WORLD, New Bridge-street, not later than the last Tuesday in each month. Articles arriving after that time will be placed in the following month's competition.

Written competitions must be on one side of the paper only. The contributions must be original, and relate to matters connected with Engineering, Mechanism or Electricity.

The Proprietors of THE MECHANICAL WORLD reserve the right to publish any competition, whether it gains a prize or not.

The competitions may be accompanied by diagrams, sketches or drawings.

Competitors should write the words "Prize Competition" on the envelopes.

Competitors are not confined to one, but may send any number of competitions.

The correct name and address of the sender must be distinctly written upon every competition, not necessarily for publication. Competitions can appear under a *nom de plume*.

☞ We cannot undertake to be responsible for any MSS. sent to us, though when stamps are enclosed for the purpose we will endeavour to return rejected contributions.

Miscellaneous Items.

An electric tramway is to be constructed between Prague and Vrsovic, a distance of nearly three miles.

Arrangements are being made to work coal in Alaska this year. Gold mining is also to be commenced.

Experiments are being made in the German Army with aluminium as a means of reducing the weight the men have to carry. The various articles of their equipment are made of this metal.

The death is announced of Mr. John Hopkins, at Bristol in his 85th year. Mr. Hopkins was a well-known figure in engineering circles, and had held appointments in the locomotive departments of the Taff Vale Railroad Company and the Bristol Steam Navigation Company. Subsequently he was engaged at the Great Western yard at Bristol. He also took an active part in the construction of the steamship "Great Britain."

Of the double railway passenger lines in the United Kingdom 98 per cent. of the mileage is worked on the absolute block system, which in great measure explains our immunity from railway accidents. A year ago 95 per cent. was worked on the block system, so that we are approaching towards unanimity. There are 10,009 miles of railway, double line, open, the increase on the year being 41 miles, and on the block system there are 10,650 miles, the remainder being worked simply by telegraph.

Professor Thurston, the well-known professor of engineering at the Cornell University, U.S.A., has recently introduced an improvement in the carbons of arc lamps, whereby the irregular working of the lamp, owing to the carbons occasionally shaking past each other, is obviated. Professor Thurston arranges the carbons in planes intersecting at a small angle, the angle in practice being such as to be just sufficient to prevent the carbons from passing each other and not so large as to make any difference in the length of the arc formed between the centre and the ends of the carbons.

Passengers to and from the Continent *via* Dover are now required to pay 1s. tax, the Government having empowered the Dover Harbour Board to make this levy towards the cost of the new port. Arrangements have been made to include the sum in the fares.

Some remarkable statistics with regard to British railways have been given to the Labour Commission by Sir George Findlay, general manager of the London and North-Western Railway. He said that the capital actually raised amounts to £897,000,000; that the receipts from railway traffic reach £80,000,000 a year, or nearly as much as the National Revenue; that £43,000,000 are paid as wages, and that employment is found, directly or indirectly, for 500,000 men. About 61,000 men are employed on the North-Western system alone.

The first girder of the South Shore Pier, Blackpool, was placed in position on the 1st inst. Messrs. Butler and Co., of Stanningley Ironworks, Leeds, have made excellent progress with the erection of the pier. Although it is provided in their contract that the pier should be completed by Whitsuntide of next year, the erection has proceeded so rapidly that it is anticipated everything will be ready for the formal opening by Eastertide. The piles which will support the pier number 463, and only 60 of these yet require to be driven.

If carbon monoxide be passed over heated nickel reduced by hydrogen, a volatile nickel compound is obtained, to which Mond, the discoverer, has given the name nickel tetracarbonyl. This substance dissolves easily in petroleum, and the solution can be used in nickel plating. Regaud has with this solution succeeded in nickel plating copper wire, it being done in the following manner:—The wire is unrolled and placed in a tray filled with the solution, where it rests upon two metal plates. A current of sufficient intensity is then turned on to heat the wire to from 90° to 100°. At this temperature the nickel compound decomposes, and the nickel is deposited upon the wire. It seems to adhere well.

Queries.

☞ Readers are invited to avail themselves of this section for practical information on questions relating to Mechanical Engineering and the Scientific Industries.

☞ Queries and Replies should arrive at the Manchester Office not later than by the first post on the Tuesday preceding the date of publication.

MAKERS OF CELLULOID.—Required the names and addresses of extensive makers of celluloid.—B. P.

MAKERS OF STAMPED FORGINGS.—Required the names and addresses of firms making drop stamped joints and pins in small quantities.—J. T.

NICKEL.—In an alloy of cast iron and nickel what is the increase in strength over cast iron, and what proportion of nickel should be used?—T. C.

ECONOMISER SCRAPERS.—What means must I adopt to renew some broken scrapers in the middle of the range of pipes in the economisers?—PUZZLED.

PATTERNMAKER'S TOOL BOX.—Will any reader give me a sketch of the patternmaker's tool box, with full dimensions and particulars?—APPRENTICE.

MAKERS OF COMPRESSED PAPER.—Will any reader inform me of the address of a maker of compressed paper, such as used for carriage wheels and the like?—T. D.

RIFLING MACHINE.—I should be glad of a sketch of any appliance used for rifling out small barrels, such as revolvers, etc., say ¼in. to ⅝in. bore, with threads, say, 6in. pitch.—NEMO.

WOVEN BELTING.—Can anyone give me the recipe for or supply me with the proper paint for cotton belting? I can weave it right enough, but cannot get a satisfactory paint.—BARCELONA.

HARDENING CIRCULAR SAWS.—Can anyone tell me how to harden a circular saw 20in. diameter and ⅛in. thick, to saw cast iron? I want to harden the cutting part only, and not the body of the saw.—J. WILSON.

HOT-AIR ENGINE.—Will some reader of THE MECHANICAL WORLD kindly oblige me with a section and principal dimensions of a ½H.P. single-acting hot-air engine of the Stirling cycle?—GEO. H. PERKINS, North Queensland.

ROLLER-BORING TACKLE.—Will some reader favour me with a sketch of a tool for boring hard wood rollers of various kinds in the lathe from 1ft. to 3ft. in diameter, and from 3ft. to 5ft. long? The holes are to pass right through, and to be from 1in. to 3in. diameter.—BORE.

LOSSES IN STEEL FURNACES.—Could any reader kindly inform me the average per cent. of actual loss, and the average per cent. of skull, in the charge of a Siemens open-hearth steel furnace working charges of from 30 to 40 tons? And also the per cent. of loss in heating slabs and ingots in the Siemens regenerative gas furnace?—J. R. R.

BOAT PROPULSION.—If a boat floats down a river, will it be carried forward at the same speed as the stream is flowing? Or can it be proved that it will go slower than the stream. How much force in lb. will be required to propel a boat of a given weight against a stream or up a river flowing with a certain velocity, so that the boat shall move up the river with the same speed that the stream is flowing down?—HYDRA.

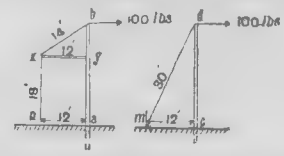
WATER FLOWING INTO JET CONDENSER.—Will some fellow-reader kindly give me a worked-out example of the quantity of water that will flow through a 4in. pipe 30ft. long, with four bends, into a jet condenser with 18in., 24in., and 28in. of vacuum; wheel valve wide open, giving same area as pipe; also with it half open? The water supply tank is 8ft. below condenser. The condenser is working on a set of triple-expansion engines. What effect have bends and temperature on supply water?—SUGAR MILL, North Queensland.

LOCOMOTIVE CONSTRUCTION.—Will any correspondent enlighten me as to the mode adopted in locomotive work in order to fix the position of the axles (horizontally) so that each axle may have a predetermined portion of the total weight resting upon it? Say:—

Load on leading axle	0·32
„ driving „	0·48
„ trailing „	0·20
	1·00

Of course, I am aware there are certain circumstances—such as length of barrel, position of firebox, etc.—which in practice to a great extent influence this, but the point I wish clearing up is: Given the total weight, how are the positions of axles determined so that the pre-arranged weights rest on them? An answer would be of service to others as well as to—HILLSLAND.

STAYING TELEGRAPH POSTS.—*a b* and *c d* are two telegraph posts of equal height, firmly fixed into the ground. How can *m d* be



proved to be a stronger way of staying than *n x b*? Also, what is the compressing thrust on the strut *x y*, and the bending moment about *y*?—TELEGRAPH POST.

Replies.

☞ Owing to the constant increase in our correspondence we regret that we have no alternative but to announce that we cannot reply by post to Queries even when stamped envelopes are sent.

☞ Queries and Replies must in all cases be accompanied by the names and addresses of the writers, as no notice will be taken of anonymous communications.

INVENT.—No address is given in your letter.

HYDRA.—The total pressure on the book will be slightly over one ton.

FITTER.—Messrs. Eyre and Spottiswoode, East Harding-street, Fleet-street, London, E.C.

J. T. W.—No, we think not. Messrs. Joseph Wright and Co., Tipton, are the makers of the Berryman feed-water heater.

BAR.—Messrs. Craig and Donald, Johnstone, near Glasgow, make rail and bar-cutting machines such as you require.

W. WILSON REDHEAD.—"The Engineer and Draughtsman's Data Book," by R. White, will suit you. The price is, we think, about 2s. It may be had from our office.

GLAMORGAN.—Try Messrs. A. and J. Stewart and Clydesdale Limited, who are large makers of all kinds of iron and steel boiler tubes, and who will doubtless be able to supply you.

J. H. B.—What is intended to be implied in the article in question is that the possession of a British patent specification and seal does not guarantee the validity of the patent, because no search as to novelty is made by the patent office authorities. If a man holds a British patent, a foreign manufacturer cannot sell similar machines in England, though he may by some means or other have obtained a foreign patent. He could not make the machines here either. A valid patent cannot be obtained in France, Germany, and Switzerland after the British complete specification is published. Up to that time, although the invention may have been manufactured here, valid patents can be obtained in the countries named, and also in most of the remaining European countries, British Colonies, and America and Canada. The manager of our patents department will be pleased to give you any further information desired on application to him, or he would be pleased to see you here, if you like to call.

CRUCIBLE.—Will any reader inform me how plumbago crucibles are made for melting brass and steel; also sketch of machine for making same?—PLUMB.—*A.*—If "Plumb" will consult Mr. W. H. Greenwood's "Manual of Iron and Steel," pages 24 to 30, he will find all the information and sketches that he may require. Also from pages 419 to 427 "Plumb" will find some very useful information on the heating of crucibles.—J. MORGAN.

HEAD-GEAR FOR COLLIERY.—I have contracted to make a pitch-pine head-gear for a colliery. The pitch pine is 16in. square, and the head-gear is to be 35ft. high; also, it has to be placed on either brick or stone pillars 15ft. high. Can anyone inform me of a good plan to get it to the top of these pillars, or will someone kindly show me how I am to get it into position?—ALPHA.—*A.*—If "Alpha" will communicate with me at the following address I will show him how to get the head-gear up in position.—W. OLDHAM, c/o Mr. Machin, Holloway, near Cromford, Derbyshire.

Latest Inventions.

APPLICATIONS FOR LETTERS PATENT.

When Patents have been "communicated," the name of the communicating party is printed in italics.

Where complete specification accompanies application, an asterisk is suffixed.

25th July, 1892.

7404A DYNAMO ELECTRIC MACHINES and ELECTRIC MOTORS. S H Short.

13,507 CONDUITS WITH INSULATORS for UNDERGROUND CONDUCTORS for the DISTRIBUTION OF ELECTRICITY. W H Scott.

13,510 STEAM PIPE COVERINGS. A Oertgen.

13,514 TUBES for STEAM BOILERS. O Meredith.

13,528 FOG SIGNALLING APPARATUS for RAILWAYS. J Hart and J Parson.

13,541 MANUFACTURE of CONTINUOUS LENGTHS of TUBE by ELECTROLYSIS. F E Elmore.

13,512 TANKS or CELLS for ELECTROLYSIS. F E and A S Elmore.

13,543 ELECTRICAL INSTALLATIONS for PRODUCING ALTERNATING CURRENTS. Siemens Brothers and Co. Ltd. (*Siemens and Halske*, Germany.)

13,545 STEAM ENGINES. C Wells.

13,546 AIR-BLAST APPARATUS for FURNACES.* M Neuerburg.

13,548 APPARATUS for PRODUCING CURVED PIPES. H J Haddan. (*E Krohn*, Germany.)

13,549 DYNAMO ELECTRIC MACHINES.* F V Andersen.

13,553 LOCOMOTIVE STEAM ENGINES. J Armstrong.

13,555 MANUFACTURE of ALLOYS and in the PURIFICATION THEREOF.* J B Torres.

13,557 ELECTRIC TRACTION for RAILWAY TRAINS and TRAMWAYS. W P Thompson. (*La Société Anonyme pour le travail electrique des métaux*, France.)

13,559 TELEPHONIC PLANT for PRIVATE and DOMESTIC USE.* J Cerpaux.

26th July, 1892.

13,532 ELECTRICAL ACCUMULATORS for SECONDARY BATTERIES.* D Young. (*A E Colgate*, United States.)

13,571 GENERATION of STEAM POWER.* C C Peck.

13,572 SCIENTIFIC GAS ENGINE. J Wilkinson and R R M Balderston.

13,574 RAILWAY CHAIRS. J R Peacock.

13,577 SMOKE TESTING MACHINES for TESTING DRAINS, etc. J Macleish.

13,589 STEAM BOILERS.* L W Lester.

13,592 RAILWAY CHAIRS. A and T Leadbeater.

13,595 APPARATUS for VARYING the STRENGTH and DIRECTION of ELECTRIC CURRENTS. J A Ewing and C G Lamb.

13,601 ARTIFICIAL FUEL.* R F Strong and A Gordon.

13,605 FEATHERING PADDLE WHEELS.* G T Rignel.

13,607 MINERS' TOOLS.* N W Moodey.

13,608 METALLIC WAGONS.* W P Thompson. (*W Bettendorf*, United States.)

13,609 AUTOMATIC RELIEF VALVES.* W P Thompson. (*F Schreidt*, United States.)

13,614 STEAM BOILERS.* H J Haddan. (*A Stirling*, United States.)

13,616 AUTOMATIC WEIGHING APPARATUS.* R Haddon. (*J P Baldwin*, United States.)

13,617 PIPE and NUT WRENCHES.* H Bornstein.

13,619 ELECTRICAL FIRE ALARMS. W H Munns. (*A H Brintnell*, Canada.)

13,620 PLANES. W A Bramley.

13,625 GAUGE or MEASURING APPARATUS. G R Hughes.

13,626 VALVES for STEAM or HIGH-PRESSURE FLUIDS.* W G Adams and J S Forbes.

13,627 PIPE JOINTS. J E and H Howard.

13,630 ACOUSTIC TELEPHONES.* A L Simpson.

13,640 TOOTHED and OTHER GEARING. A Desgoffe and L A di Giorgio.

13,645 ROTARY ENGINES, PUMPS, or MACHINES.* E Waldron.

13,648 ELECTRIC RAILWAYS.* M W Dewey.

27th July, 1892.

13,661 RAILS, SLEEPERS, and CHAIRS for COLLIERY TRAMWAYS.* J Ford.

13,664 RAILWAY CHAIRS. T T M Lumsden and J McIver.

13,670 MITRE CRAMPS. G Greenway.

13,676 WATER-COOLING APPARATI for GAS, OIL, CARBON, and STEAM CONDENSING ENGINES. W Adkins.

13,683 APPARATUS for STARTING ELECTRIC MOTORS. T R Andrews and T Preece.

13,691 AUTOMATIC APPARATUS for ADJUSTING the WIRES of DISTANT RAILWAY SIGNALS.* E Russell.

13,692 INTERLOCKING APPARATUS for RAILWAY POINTS and SIGNALS. E Russell.

13,693 RAILWAY FOG SIGNALLING APPARATUS. G Musgrave and others.

13,694 ALTERNATE CURRENT TRANSFORMERS. W C Johnson and T Boyden.

13,698 TREATMENT of MANDRELS for ELECTROLYTIC DEPOSIT of METALLIC TUBES. F E and A S Elmore.

13,699 INSTRUMENTS for RULING LINES. H H Share.

13,706 HYDRO-CARBON MOTORS. F Sonnenberg and C V Z F de Friedland.

13,710 FOUNDRY MOULDING APPARATUS. T and J R Ashmore.

13,714 SAFETY CRANE. K Schultz.

13,717 IMPROVEMENTS in CUT-OFF GEAR in STEAM ENGINES. M H Robinson.

13,718 CONDUITS for ELECTRIC MAINS. H L Doulton and C E Morris.

13,719 IMPROVEMENTS in CUT-OFF GEAR in STEAM ENGINES. M H Robinson.

13,722 CLUTCH or MOTOR for the TRANSMISSION of POWER.* D W Carter and others.

13,725 CENTRIFUGAL VENTILATORS and PUMPS. C Wenner.

28th July, 1892.

13,729 METAL BEARING or JOURNAL FITTED with REVOLVING ROLLER. J Bradshaw and F Grimsley.

13,734 DIFFERENTIAL PULLEY BLOCKS and HOISTS. W T Eades.

13,741 APPARATUS for CUTTING and WINDING WEBS of PAPER. T T M Lumsden.

13,744 POLISHING MACHINES. E Taylor.

13,745 SCREW-CUTTING MACHINES. T B Smith.

13,750 SHEET METAL BALLS made of TWO HALVES without SOLDERING. O Callmann.

13,751 WATER METERS. J Holdroyd and E Wiseman.

13,752 PREVENTING SEGREGATION in LARGE INGOTS. R W James. (*W R Hinsdale*, United States).

13,755 GAS ENGINE STARTING GEAR. J Higginson, jun.

13,760 JOINING EDGES of SHEET, STRIP, and THIN PLATE METAL, for the PURPOSE of FACILITATING the MANUFACTURE of TUBES, and CISTERNS. F A Williams.

13,763 INCANDESCENT ELECTRIC LAMPS. J B Lee.

13,764 SECONDARY BATTERIES. J B Lee.

13,765 ALTERNATE CURRENT ELECTRO-DYNAMIC MACHINES. M Hutin and M Leblanc.

13,769 CONVERTING a GAS ENGINE into an OIL VAPOUR ENGINE. T H Stringer.

13,770 STEAM or GAS TURBINE WHEELS. C C G P de Laval.

13,780 SIGNALLING and CONTROLLING the MOVEMENTS of TRAINS. H W Tanner and R H Richardson.

13,782 ROUGHING DOWN INGOTS for HEAVY SECTION IRON.* C P Schumacher.

29th July, 1892.

13,784 MARINE STEAM ENGINES. A C Kirk.

13,790 HOISTS. The Garner Patent Safety Hoist Company Limited and J Garner.

13,793 APPARATUS for the CONSUMPTION of SMOKE in the FURNACES of STEAM BOILERS.* H G Hudson and others.

13,807 APPARATUS for HEATING FEED WATER of STEAM BOILERS. C E Hudson.

13,817 SMOKE-CONSUMING APPARATUS. D Durbec.

13,824 HYDRAULIC MOTOR. J Molas.

13,827 THRUST SHAFTS.* T Putnam.

13,831 TUBULAR STRUCTURES FILLED with GASEOUS FLUID, APPLICABLE for BEAMS or SUPPORTS.* J Soumovski.

13,833 COAL-CUTTING MACHINES. A Greenwood.

13,836 MACHINERY for the MANUFACTURE of the LINKS of METALLIC CHAINS, etc. W Fiddian.

13,838 MEANS in RAILWAY TRAINS FITTED with PNEUMATIC BRAKES for ENABLING PASSENGERS to SIGNAL the DRIVERS and GUARDS.* J Gresham.

13,839 RATCHET for DRILLING, BORING, etc. T Haggart.

13,840 APPARATUS for the MANUFACTURE of WELDED HOLLOW ARTICLES. R Blasberg.

13,841 UTILISATION of EXHAUST STEAM from STEAM ENGINES. T R Hanmer and G Tyldesley.

13,847 CARBON PRODUCT.* L S Langville.

13,848 THERMOSTATIC FIRE ALARMS.* H H Lake. (*G D Mosher* and *S Novitzky*, United States.)

13,850 INCANDESCENT ELECTRIC LAMPS. Sir C S Forbes, Bart.

30th July, 1892.

13,856 ELECTRIC BELLS. G Bingswanger and H J Coates.

13,859 GAS ENGINES, SELF-STARTING. J P Binns.

13,878 WATER GAUGES.* J A Fletcher and others.

13,879 TELEPHONE RECEIVERS. E W L Harrison and S Murray.

13,881 TREATMENT of METALS for ORNAMENTAL PURPOSES. R N Coldwell and J Davis.

13,885 STATION INDICATOR for RAILWAYS. A W Robinson.

13,886 FASTENING "VIGNOLE" RAILS to METALLIC or WOODEN SLEEPERS. J Petitjean.

13,887 ROTARY STEAM ENGINES. W Ellis.

13,888 APPARATUS for SIGNALLING, ADVERTISING, or EXHIBITING ANNOUNCEMENTS by MEANS of SEARCH LIGHTS. J S W Hodges.

13,897 TRAIN SIGNALLING APPARATUS. J W Maycock.

13,904 TREATMENT of SEWAGE by MEANS of the LIQUOR OBTAINED from IRON PYRITES BEDS. J H Kidd.

13,906 STEAM BOILERS. W Dalton.

13,913 MOTIVE POWER. C Tellier.

13,919 INCANDESCENT ELECTRIC LAMPS.* E Thomson.

13,920 REGULATING ELECTRICALLY-DRIVEN MECHANISM.* W H Knight and W B Potter.

13,923 FEED-WATER HEATING and WATER-CIRCULATING APPARATUS for STEAM BOILERS. D B Morison.

13,924 BLOWING and PUMPING ENGINES. J Wheelock.

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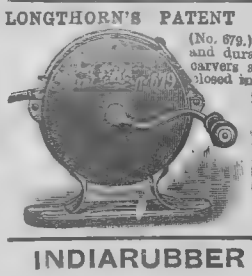
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FRIDAY, AUGUST 19TH, 1892.

British v. American System of Patents Protection.

SEEING that the question of an alteration in our system of patents protection has during the recent elections been brought very much to the fore, and that a local engineering contemporary, which professes to have quite an installation, so to speak, of *patent editors*—and if that be really so, ought to know better,—has entertained its readers with an effusion on "Reduced Patent Fees," stating that "the much-vaunted system of American practice of examination and searching is one, however, which is a set-off against the higher fees charged in this country. . . ." it will doubtless be interesting to our readers to briefly compare the two systems of examination in vogue in both countries. When a patent is applied for in our own country, say, under a provisional specification, the duty of an examiner is to ascertain and report to the Comptroller of Patents whether the invention has been fairly described; whether the application form, specification and drawings — when the latter are filed with the application, which is extremely rare—have been prepared according to rule; whether the application contains more than one distinct invention; whether it is against law and order, and whether the title sufficiently indicates the subject matter of the invention. When a complete specification is filed after the provisional, the examiner has, in addition to the above duties, to ascertain if the invention described in the complete specification is based upon that described in the provisional. A little reflection will show the reader that not one solitary word is said about searching the records to ascertain if an invention possesses novelty, and a little practice at applying for patents will convince him of the fact. It is notorious that in some classes of inventions as many as fifty patents have been applied for *and granted* for exactly the same invention, and that this holds good more or less in all classes; whilst the absurdity of saddling the examiner with the duty of ascertaining, from so designedly vague a document as a provisional specification, whether such fairly describes the invention, would surely appeal for redress even to the superior judgments of *patent editors*. The whole proceeding is a farce. The examiner is not even responsible for correct spelling, whilst some complete specifications are allowed to pass the claiming clauses of which refer to qualities of the invention and not to the claiming of parts of machinery, the ostensible object of the application. The title should sufficiently indicate the subject matter of the invention!! What for? Simply to serve as a record. But, lo! if it does not, the validity of the patent is at stake, and the examiner is powerless to save it, simply because it is impossible to fix a correct title until he has seen the complete specification and drawings, when it is too late. Besides which the fixing of an invention under a particular title ought not to form a means by which the patent may be rendered invalid. We have not space at our disposal to go fully into the matter of disconformity between provisional and complete specifications, but may say that several good patents have been adjudged invalid on this account. Of course the specification may be amended, but as a matter of fact in the great majority of cases it is only when a patent is contested in the Courts at great expense that the disconformity is found out. It will thus be seen that the British patentee has no guarantee whatever as to the validity of his patent even though he is armed with a printed specification and the Great Seal. Let us now see in what the American system consists. In the first place, an applicant for a patent has to file a specification and drawings fully describing and showing the invention, and concluding with the claiming clauses. The specification is entered and in due course examined, the duty of the examiner being to ascertain the *novelty of the invention*, by searching through the records of both British and American patents, and to cite against it all such patents as have any bearing upon the invention. He then makes out a report, and the case is argued between the inventor's agent and the examiner, and the points of novelty decided in this way, and at no extra cost. The examiner also points out any mistake in spelling, assists in the correct wording of the claiming clauses by suggesting what should or should not go in in view of the references, whilst there is no trouble about disconformity between two specifications, since there is no real system of provisional protection. The examiner, with the cognisance of the agent, also provides the correct title *after he is in full possession of the facts*, and even then the validity of the patent does not depend upon its wording. We submit that this system of examination and searching is much simpler than our own, to say nothing of its eminently practical utility; and when we mention that the majority of British patent agents advise the taking out of an American patent in order to get the examiner's report, which they prize as a highly useful document, it is needless for us to take much note of our contemporary's sneer that "the anticipations discovered by them (the examiners) are sometimes truly wonderful." Besides which, if an inventor here desires to ascertain what is being done by others in the same line of business as himself, it is necessary for him to keep ceaseless vigil on the specifications as they are published by the Patent Office. We are not, however, quite prepared to go the whole hog in the matter of the American system of protection, but what little we have said will doubtless serve to show that there is much in the American system that we could copy with advantage.

Electrical Transmission of Power.

AN important installation for the electrical transmission of power is now approaching completion in the San Antonio Cañon, in South California. The power is obtained from water where there is a flow of 1300cub. ft. of water per minute, and which, after passing through 30in. and 24in. double-riveted sheet-iron pipes laid for its conveyance, yields an effective head of 390ft. There are four double-nozzle Pelton water wheels 34in. in diameter, coupled direct to the armature shafts of four Westinghouse alternating current dynamos of 200H.P. each. The exciting current is furnished by two dynamos, also operated by Pelton wheels. By means of step-up transformers, the pressure of the current will be raised at the generating station to 10,000 volts, being the same as that used from the Deptford station. From here the current will pass along two overhead copper conductors for a distance of seven miles down the cañon to a point where they diverge. One then passes to Pomona, 15 miles, and the other to San Bernardino, 28 miles, or in this case 56 miles with the return circuit. Sub-stations have been erected at these towns, and here the 10,000 volt current will, by step-down converters, be reduced to about 1000 volts and then distributed for both light and power purposes. This installation, which will be the largest of its kind for commercial objects in the United States, will shortly be set in operation, and will doubtless be the forerunner of many similar instances of electrical transmission of power over long distances in that country.

Electric and Cable Railways in the Metropolis.

A BLUE BOOK has recently been issued by the Corporation of the City of London dealing with the Electric Railway Bills introduced in the late Parliament. It comprises a report by the Local Government and Taxation Committee of the Corporation, who retained as engineer the services of Colonel Haywood, with whom was associated Mr. J. Wolfe Barry. A series of nine questions was drawn up by the committee, and the engineers asked to report upon them. With regard to the adequacy of the proposed railways (the schemes for which have already been referred to in this journal) for present and future traffic, it is stated that the lack of connections with existing railways is a matter which deserves careful attention. This will be evident from the fact that the convenience of the public would be better served by a series of railways communicating with each other and with the suburbs than by isolated lines between certain points within strictly urban districts. The proposed routes to be followed by the lines are considered by the engineers to be the best in the interest of the public. Another important point in the report is the question of gauge. This, it is regarded, should be uniform, and conform to the standard gauge of the country, and that, moreover, the tunnels should be made of such dimensions as to admit of the rolling stock of other lines to pass through them. If the companies were compelled to do this, they state that the cost of constructing the lines would be so great as to make them despair of raising sufficient money to carry out the undertaking. With this statement before them, the Local Government and Taxation Committee of the Corporation refrained from giving their adhesion to this objection. The report of the engineers was submitted to the Parliamentary Committee, and although they approved of the recommendations generally, they declined to take the responsibility of insisting upon that particular one.

Electricity and Steam on Railways.

THE notion entertained by some, that electricity must supplant steam on all railways within a very few years, is shown by Mr. Arthur T. Woods to be an error. At present the highest efficiency of an electric-railway system—the current being distributed from a steam-generating station—is only 60 per cent.; and it is calculated by Messrs. Crosby and Bell that this would give results greater than those of steam only at speeds exceeding 140 miles per hour; while, to compete with steam at a speed of 60 miles per hour, the efficiency of the electric service must be raised at least to 80 per cent. The evolution of an electric system giving this efficiency is likely to require considerable time. Mr. Woods concludes that electricity is not likely to replace steam for long-distance freight traffic; that there is a possibility that it may be economically substituted for steam for high-speed service wherever the traffic is sufficient to justify the construction of tracks separate from those used for moderate speeds; that in only very few localities in the United States are the conditions such as to make such substitution now commercially possible; that on a few short lines the passenger traffic is such as to make electricity a possible form of motive power at present speeds; that it is probable that electric locomotives will be used in tunnels and for switching in cities; and that no electric locomotive capable of doing the work of a medium-weight steam locomotive has yet been constructed.

State of the Skilled Labour Market.

THE Labour Correspondent to the Board of Trade states that during the past month the labour market has been in a condition of comparative peace, and that there have been few disputes of any importance to record. In all only 35 strikes have been noted, as against 59 in the month preceding. The numbers involved in each case are also much less, so that as a matter of fact there has been less disturbance of labour relations from this cause than for a very long time back, and this notwithstanding the fact that several important reductions of wages have been effected in a few trades and localities most affected by the scarcity of orders. Of these strikes eight have been in the coal trade, eight in the building trades, six in the cotton trades, three in shipbuilding, two in the engineering and iron and steel trades, and the remainder among lesser industries. Apart from this, however, there cannot be said to be any real improvement in the demand for labour, although the figures given in the reports of the trade unions which have made returns to the Board of Trade are fractionally better than for the previous month. Twenty-two trade unions have sent in reports. These show an aggregate membership of 268,355, which is an increase upon the total of last month. Of this number, 13,464 were shown to be out of work, against 13,550 in the last return. There is thus a proportion of 5·02 per cent. of skilled workmen in the trades out of employment, as against 5·15 in the month before. Small as this improvement is, it is entirely due to what seems a slight rally in the shipbuilding trade, employment having been found for 487 men who last month were out of work. The proportion of unemployed in this industry has in consequence fallen from 10·9 to 9·6 per cent. The steel trade is also slightly better, but beyond these there seems at present neither sign nor likelihood of improvement. In shipbuilding districts the demand for pattern-workers is weak, and this must be taken as a sure indication that, in most branches of the iron-founding and engineering trades, prospects for the latter end of the year are not very encouraging.

Famous Firms.

(By Our Special Correspondent.)

MESSRS. RUSTON, PROCTOR AND CO. LIMITED, LINCOLN.

THE Sheaf Works, Lincoln, owned by Messrs. Ruston, Proctor and Co. Ltd., are famous the world through for the excellence of the work turned out; in fact, "thoroughness" seems to be the motto of the firm to-day, as it has been for the more than thirty-five years that have elapsed since Mr. Ruston first acquired a small millwright's business in Lincoln for the purpose of making portable and other small engines, adapted in the main for agricultural purposes. After an extended tour through the premises we are able to say, after a wide experience of engineering works, that we never saw a place more perfectly adapted for the work to be done, or where more care was taken that the facilities provided were fitly utilised.

In the infancy of the concern, portable and small engines, thrashers and saw benches were the chief things turned out, whereas now there is scarcely anything the firm cannot supply. A mere description of the standard types of engines and boilers made by Messrs. Ruston occupies over a hundred pages in their catalogue.

The original business was started in 1840. This was acquired by Mr. Ruston in 1857, and to-day there are over 1800 men employed in works that cover upwards of 17 acres. In the last 15 years the hands employed have increased by 1000. Twenty-two engines, of some 450H.P. in all, are required to run the machinery, whilst a couple of locomotives are fully employed in moving the raw material, etc., about the shops and yards.

We first of all obtained a general idea of the works under the guidance of Mr. Weatherly, one of the staff, and afterwards, through the kindness of the same gentleman, were conducted by him to the various shops, in order that we might avail ourselves more fully of the opportunity of witnessing in detail the elaborate processes through which both the raw and finished material passed before its final completion for the engine or machine for which it was designed. The works consist of two distinct establishments—the iron, or engine works, and the wood works, the latter devoted to the building of thrashing machines—a branch in which the firm do an enormous and a constantly increasing business.

The two works are a considerable distance apart, though both are on the banks of the river Witham. The engineering works proper are divided into two parts by the Sincil Dyke, and are conveniently situated adjoining the Manchester, Sheffield and Lincolnshire Railway Company's line, with which they connect by means of sidings. From these sidings lines radiate into every part of the works to or from which the raw material or finished goods require to be carried. A line runs at each end of the enormous fitting, turning, and erecting shops, goods being moved thereto by means of some exceptionally fine overhead cranes, by Messrs. Vaughan and Son, of Manchester.

Everything that goes into or out of the works is passed over a weighbridge, which affords a useful check on traffic charges, as well as on the weight of incoming and outgoing goods. We wonder this system of weighing is not more generally adopted, as it certainly would pay.

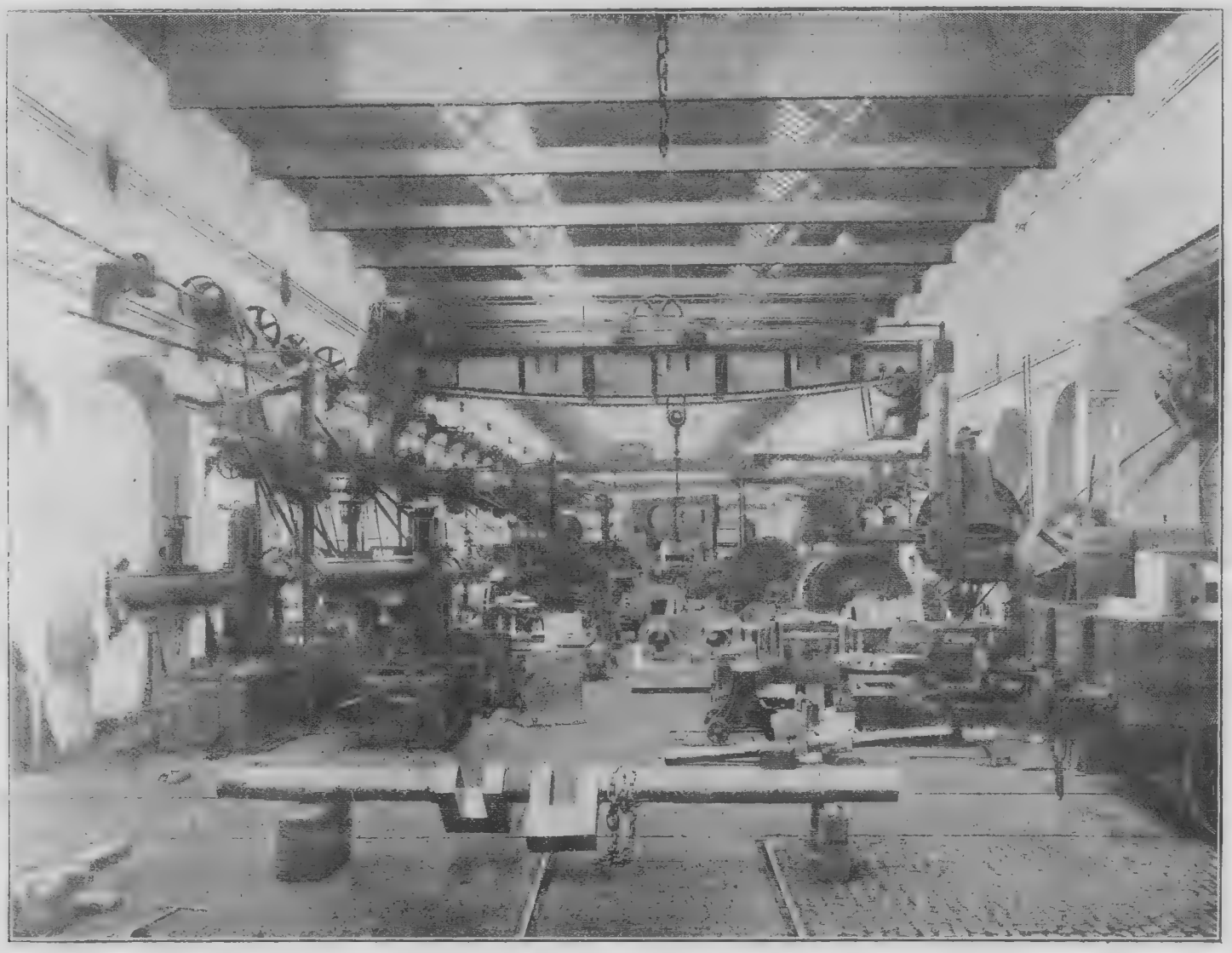
On the other side of the bridge which crosses the Sincil Dyke, is the blacksmiths' shop, where some nut-making tools were doing good work. More room is sorely needed here; but the best has to be made of the floor space that exists. The management evidently do not believe in waste—a fact amply proved by an ingenious arrangement by which the superfluous heat from a furnace is made to do duty under three boilers and in three other furnaces before being allowed to escape into the outer air.

Crank making next occupied our attention, and after a glance at a vertical and horizontal drill doing good work, we leave the fine shop and pass on to the boiler shops.

The boiler shops are large, well lighted, and most conveniently arranged. What chiefly strikes the visitor is the vast number of modern machines seen on every hand. The firm evidently believe very strongly in having everything necessary for good and quick work, and having that of the very best possible. We may just say here that under the direction of Mr. Vaughan, the works manager, to whom we are indebted for much information, and to whom we are pleased to take this opportunity of tendering our thanks, many special tools have been designed and made for facilitating the execution of the work. The shops, as we have before indicated, are served by four overhead cranes by Messrs. Vaughan, which we were told gave perfect satisfaction.

Passing a 30ft. boiler and a powerful hydraulic press, we watched a flanging machine at work. "When I came here," says my guide, "we used to have all plates flanged by mallets at a cost of £1 for each plate, and only a small one at that. Now see the difference." A difference, indeed. In the flanging machine, for pressing the tube plate and firedoor plates for the fireboxes, and for pressing the ends of Cornish and Lancashire boilers, the table which carries the lower die is lifted by small rams, which are of sufficient size to raise any weight that may come upon the table; they at the same time raise the plunger of a large ram. When so lifted, water runs freely from the ordinary water supply into the large ram cylinder; the latter is thus filled with water up to the point at which the heavy work of pressing commences. At this point, and not until then, the water which has been forced through the high-pressure pumps is admitted. The accumulator water used is thus reduced to that necessary to raise the small rams, and to complete the last two or three inches of the stroke of the large ram. The arrangement is originally an idea of Messrs. Ruston, Proctor and Co. Ltd., and has now been adopted by others, as it saves the pumping of a good deal of water. For flanging the ends of the short sections of the long tubes used as furnace flues of Cornish and Lancashire boilers, a machine is employed in which the short tube rests upon, and is attached to, a revolving faceplate, set at an angle of about 30° from the horizontal. The frame of the machine carries three fixed and one movable small roller, by means of which the cylindrical upper heated end of the revolving tube is rapidly pressed and spun into the form of a flange. A 30in. tube end in this way takes about four minutes to flange once it is heated and placed on the machine.

(To be continued.)



FITTING, TURNING AND ERECTING SHOP.—MESSRS. RUSTON, PROCTOR AND CO. LIMITED.

IT is stated that, after 15 years' experimenting, the Pennsylvania Railroad Company has decided to discontinue the use of steel sleepers. The steel sleepers are found to be too light, and they cannot be kept in line or made to take hold of the ballast firmly. The company is adopting steel rails, weighing 100lb. to the yard. The heaviest rail now in use on the tracks of the Pennsylvania Railroad only weighs 85lb. The new 100lb. rails will be laid as an experiment on the mountain division of the main line.

Air Compressors of the Paris Compressed Air Company.*

THE machinery described in this article has been constructed in view of the extended use of compressed air as a motive power in Paris, which the company anticipates, and which their previous establishment was inadequate to meet.

The new power-station is on the bank of the Seine, on the Quai de la Gare, and is designed for an ultimate provision of 24,000H.P. The compressed air mains and the supply and delivery pipes for water have been laid down for this capacity, but at present machinery has only been erected for the supply of 8000H.P. This is subdivided among four machines of 2000H.P. each, and four batteries of Babcock and Wilcox multitubular boilers provided with economisers. The whole of the machinery was constructed by Schneider and Co., of Creusot.

The steam engines are triple-expansion and the air compressors compound, the compressors being placed above the steam cylinders, which are vertical, direct-acting, and with three cranks on a common shaft. The speed is normally 60 revolutions per minute, with an allowable rise to 72 exceptionally. The steam is admitted at 142lb. per sq. in., and the air compressed to 114lb. per sq. in. The steam valves are of the Corliss type, with fixed cut-off in the low-pressure and mean-pressure cylinders. The cut-off in the high-pressure cylinder may be regulated by hand, and is further controlled by a centrifugal governor that prevents the speed rising above 72 revolutions, and by an air-pressure governor that prevents the pressure rising above 114lb. per sq. in. The machines rise to a height of 39ft. from the ground, and are provided with very heavy framing and anchorage. The condensers, air and feed-pumps, etc., are in a pit, 12ft. deep, below the engine-house floor.

Two of each set of three compressors feed the air into a wrought-iron receiver, from which the third cylinder draws it for the second stage of compression. The air is taken in through the roof, and reaches the compressors through hollow pillars supporting the roof.

The total weight of the set of four machines is 1800 tons. The large steam cylinders weigh 30 tons. The moving parts are in Creusot steel. The operation of the

* Inst. C.E.: Foreign Abstracts.

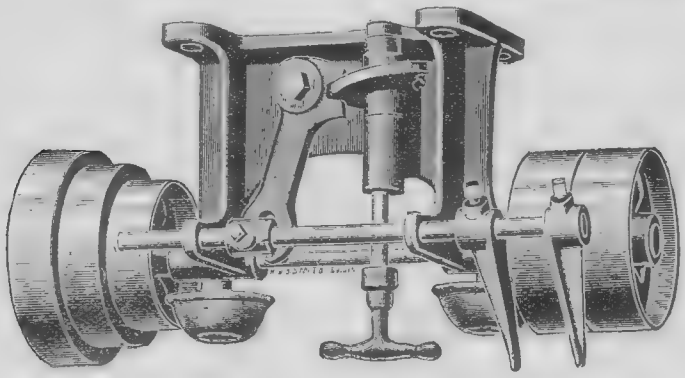
machinery has been found perfectly satisfactory from the first. The principal dimensions are :—

Diameter of high-pressure cylinders ..	35·4in.
,, mean- ,, ,, ..	55·1in.
,, low- ,, ,, ..	78·7in.
,, high-pressure compressors	30·7in.
,, low- ,, ,,	43·3in.
Stroke	55·1in.
Diameter of fly-wheels.....	18ft.
,, air pumps.....	31·5in.
Stroke of ,, ...	21·7in.
Diameter of intermediate air receivers	63 0in.
Length of ,, ,,	29ft.6in.

The article is illustrated by three engravings.

An American Countershaft.

THE small countershaft shown herewith is intended for light drilling machines, lathes, grinding machinery, and all classes of machines and machine tools. It is made with fast and loose pulleys, and cone or



AMERICAN COUNTERSHAFT.

single pulley for increase and decrease of speed. The special features are its cheapness, simplicity, and durability. There is nothing in it to get out of order, and the whole counter is self-contained and on one hanger, making it very easy to put up, and keeping always in line after being once placed.

It is designed to embody rigidity and strength, and manufacturers of tools and parties using numbers of countershafts can buy these cheaper than the old style can, it is claimed, be made. They are much superior to the old style, it is also said, as they can be put up with little trouble, and the mechanism and design are such that a quarter turn of the handle shifts the belt. The shifting device consists of a worm fastened to the handle and working in a slot in the shifter, as shown in the cut.

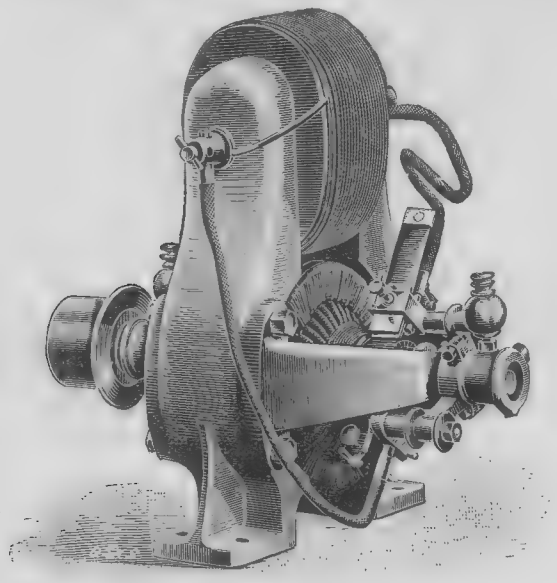
Boiler Setting.

THE brickwork about the boiler settings, says "The Locomotive," is often very imperfectly laid. It is mostly done by contract, with no one to supervise it who understands the severe use to which it is to be put. The bricklayer, who may never have worked on a job of this kind before, builds good-looking inside and outside walls, but the space between is apt to be filled with odds and ends in the most promiscuous manner. Furthermore, he puts the same joint in as he would if he were building a house, and this is just what we do not want in boiler setting, particularly in the firebrick lining of the furnace. The joints throughout the setting should be thin, and the work should be done as faithfully inside as outside. Kaolin or prepared fireclay is used in laying the firebricks, and it should be mixed up so thin that it cannot well be used with a trowel. Some millowners who have had experience in this direction will not allow a trowel to be employed at all, but require the men to use iron spoons. The firebricks should be dipped in water as they are used, so that when they are laid they will not immediately drink up the water from the cement. They should then receive a thin coating of the prepared fireclay or kaolin paste, and be carefully placed in position with as little of the kaolin or fireclay as possible. Every sixth course, beginning with the grates, should be a row of headers, *well bonded into the masonry behind*. The headers are of little use unless they are well secured into the walls of the setting, for when the lower courses of firebrick have burned away more or less, we have to rely on these headers to a considerable extent to hold the upper part of the wall in position. In repairing firebrick linings, the lower courses, which burn out fastest, can be removed and replaced without disturbing the upper part of the wall, provided the headers are secure; while, if they are not, the entire wall may have to be rebuilt, and this cannot be done without either removing the boiler or tearing down a considerable part of the setting.

A Small Electric Motor.

THE illustration herewith is of a small electric motor which has been placed upon the market by Messrs. Ernest Scott and Mountain Limited, of Newcastle-on-Tyne. It is made upon lines dictated by long practice in the designing of dynamos and motors of large capacity, and whilst of small size, embodies all the special features in engineering and electrical design necessary to ensure satisfactory working.

These motors will be found of great value for driving small workshops, lathes, machinery, fans, sewing machines, and for many other purposes where small powers are required and electric current is available. In



SMALL ELECTRIC MOTOR.

private houses and mansions, where electric light is installed, they will be found extremely useful for driving fans for ventilation, pumps for the house supply of water, churns, or butter-making machinery, saws for cutting firewood, boot-blacking, and other household purposes for which electricity might be used.

The "S.M." electric motor is made in four standard sizes, and in ordering it is only necessary to state the E.M.F. of the current and purpose for which it is required. The motors are made in four sizes—$\frac{1}{4}$H.P., $\frac{1}{2}$H.P., $\frac{3}{4}$H.P., and 1H.P. effective. They are made to run at speeds of about 1500 or 2000 revolutions, but can be wound to lower speeds if required, to suit requirements.

The Construction and Efficiency of Boilers of Locomotive Engines.*

CONSISTENTLY with the increase of steam-pressures, the boilers of locomotive engines have of late years undergone great improvement, both in design and the methods of their construction. Until recently, imperfect staying, single-riveted longitudinal lap-joints, unsupported domes, and rigid attachment to the engine frames were common, and are even now occasionally met with.

Fig. 1 gives several examples of imperfect boiler-practice. A is a section of a boiler-barrel, showing a longitudinal lap-joint below the water-line, and the bottom half of the barrel bent in to clear the eccentrics. This type of boiler was built about eighteen years ago for some outside-cylinder engines on the Caledonian Railway. Although the centre-line of the boiler was only 6ft. 8in. from the rails, such was the objection at that time to high centre-lines that the expensive mutilation shown was resorted to. It will be observed that this boiler has the top plates lapping over the bottom ones. The author has examined several old iron boilers with this kind of joint, and found in some cases grooves varying from $\frac{1}{8}$in. to $\frac{1}{4}$in. in depth running nearly the whole length of the plates. These grooves were about $\frac{1}{4}$in. above the edge formed by the bottom plate, and may be accounted for thus :—When the boilers were made, the upper half of the plate was struck to the same radius as the lower half, and afterwards bent out to form the lap. This bending placed the upper half of the ring just above the lap in a condition of slight tension, the effect of which in time became aggravated by corrosion of the metal, and by the vertical expansion and contraction of the boiler barrel. The laminæ of the iron opened, and the grooves were thus developed. A well-known boiler inspector stated, a year or two ago, that 90 per cent. of locomotive-boiler explosions were due to lap-joints placed below the water-line. B Fig. 1 shows two examples of fixing the back-plate and the boiler barrel to the firebox shell. In this case, the boiler has a raised firebox shell, and the barrel is joined to the shell by two angle-iron rings; the back-plate is also joined to the shell by an angle-iron. Objections to this method of fixing plates are—increased expense and weakening of the boiler by extra riveting and joints, and liability to laminated fracture at the root of the angle. Raised firebox shells are now obsolete, as they are not found to increase the steaming qualities of boilers, and are liable to cause priming, or burnt fireboxes through erroneous water-level. Another illustration C shows the old method of riveting the motion-plate to the boiler barrel. This rigid attachment prevents the free expansion of the boiler barrel, and causes the cross stresses in the frames and motion to be transmitted through the boiler. D shows an unsupported dome. Several accidents have happened of late years through steam-domes being placed on boilers without strengthening rings to compensate for the area of plate cut away in the barrel for the dome; and not a few boilers are at present running in this dangerous condition.

The last view E shows an objectionable way of fixing firebox crown stays. Instead of the ends of the stays resting on the extreme edges of the firebox, they fit on the edges of the covering-sheet; consequently the tube and back-plates are free to expand upwards independently of the rest of the box, and, in time, owing to the weight of the girder-stays, which are not fixed to the shell, a groove is formed round the edge of the covering-sheet, and the top of the firebox collapses.

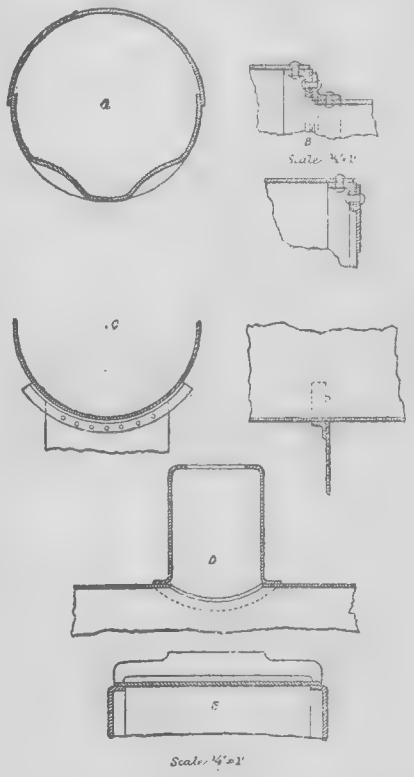


FIG. 1.

Turning to more recent practice, Fig. 2 illustrates a standard type of boiler in use on the North-Eastern Railway. It is employed for five different classes of engines, both compound and simple. The shell and barrel are made of steel. The principal dimensions of this boiler are :—Diameter of barrel, 4ft. 3in. outside; length, 10ft. 4$\frac{1}{2}$in. The barrel is made in three rings, $\frac{1}{2}$in. thick, with longitudinal butt-strips, 7$\frac{1}{2}$in. wide, $\frac{3}{8}$in. thick inside, and $\frac{5}{8}$in. thick outside the horizontal joints. These strips are double-riveted through the boiler with $\frac{7}{8}$in. rivets, 1$\frac{7}{8}$in. pitch. The barrel is flush inside from tube-plate to tube-plate. The circumferential seams are covered with rings, 5in. wide by $\frac{3}{4}$in. thick, which are shrunk on and single-riveted on each side of the seam. Although the first cost of flush barrels with circumferential butt-strips may be a little greater than telescopic barrels, yet, owing to the plates being carefully planed and put together, with the hoops or butt-strips shrunk on, the seams require less caulking than circumferential lap-joints. The steam-dome, which is placed on the centre of the barrel, is 2ft. high by 1ft. 9in. in internal diameter, and is made of $\frac{5}{8}$in. plate. The vertical seam of the dome is covered by inside and outside butt-strips, which are single-riveted on each side of the joint. Fitted inside the dome is a steel ring, to which the cover is bolted. The under side of the dome is supported by a flanged ring, $\frac{1}{2}$in. thick and 2ft. 7$\frac{1}{2}$in. diameter, equal to twice the area of the plate cut away for the dome. The boiler barrel is joined to the smokebox tube-plate, which is $\frac{3}{4}$in.

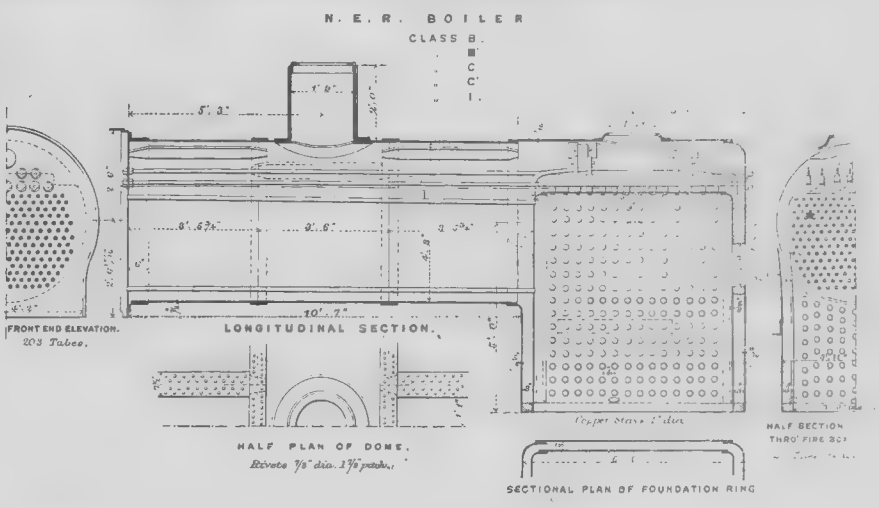


FIG. 2.

*By Geo. Harrison Sheffield. Read at a meeting of the Students of the Inst. Civil Engineers, and awarded a Miller Prize.

thick and made of steel, by a weldless steel ring, 6in. by 3⅜in. by ⅞in. by ¾in., shrunk on the barrel and double-riveted to the tube-plate and the boiler. The firebox shell is 6ft. long, 7ft. 1½in. high, and 3ft. 11in. wide; the covering sheet is $\frac{9}{16}$in. thick, and is made in one piece. There is a flanged steel ring for the safety-valve, which is placed on the centre of the firebox shell. The back-plate is $\frac{9}{16}$in. thick, flanged to a 4½in. radius, and is single-riveted to the shell. The throat-plate, which joins the shell to the barrel, is ⅝in. thick, flanged to 1½in. radius. The covering-sheet of the firebox shell is lapped over the throat-plate, which is drawn away at the edges, and is double-riveted at the end of the upper joints of the plates. The firebox is made of copper. The tube-plate is ⅞in. thick, tapering to ½in. at the base. The sides and top are in one piece, ½in. thick; the back-plate of the firebox is also ½in. thick. There is a steel foundation-ring, 3in. by 2½in., and the water-space between the firebox and the shell tapers from 3½in. at the top of the box to 3in. at the base. The copper stays between the firebox and the shell are 1in. in diameter, pitched at 4in. centres. The fire-hole ring, which is circular, is made of steel, 3in. by 3½in. in section, and 1ft. 3in. in internal diameter. There are eight cast-steel girder-stays, resting on the top of the firebox, the four centre stays being slung up to the shell by links of 3½in. wide by ½in. thick. These stays are of T section, and are 6in. high. They are fixed to the copper box by 1in. square-headed tap-bolts, which are screwed through the firebox into lugs projecting from the stays. Thus the threads are protected from corrosion, and the bolts may be readily renewed when it is necessary to put in a new firebox. The water-space between the firebox crown and the shell is 1ft. 3in. There are eleven longitudinal through-stays, 1¼in. in diameter. These stays are screwed through the back-plate, and are quite steamtight, the bolt-heads bearing against copper washers. At the smokebox end these stays have copper washers and nuts on each side of the plate. The stays are prevented from drooping by cross supports in the middle of the boiler. There are 203 brass tubes, 1⅞in. in diameter and 2¼in. pitch, giving a mean distance of ⅝in. between tubes. The distance between tube plates is 10ft. 11½in. The area of the firegrate is 17·23sq. ft. The heating-surface of the tubes is 1026·12sq. ft.; that of the firebox, 110sq. ft. Total heating-surface, 1136·12sq. ft. This boiler supplies steam to cylinders 18in. in diameter by 24in. stroke, having a combined capacity, neglecting clearance, of 12,215·2 cubic inches. This gives a ratio of 5 cubic inches of cylinder capacity to 1sq. in. of grate-area; 1 cubic inch of cylinder capacity to 12·1sq. in. of tube-heating-surface; and 1 cubic inch of cylinder capacity to 13·4sq. in. of total heating-surface.

In designing a locomotive, the first point to be considered is the size of cylinders necessary to develop a certain power. The next point is the size of boiler and the amount of heating-surface necessary to supply steam uniformly and economically to the cylinders. Yet, strange to say, in English locomotive practice the relation between cylinder capacity, grate-area, and heating-surface is often neglected; and cases are met with where engines have 18in. cylinders and 15sq. ft. of grate-area; whilst in other cases they have 18in. cylinders and 20sq. ft. of grate-area. Judging from the economical results obtained by the late Mr. Stroudley in experimenting with his boilers, it is advisable to make the grate-area as large as possible, with the normal arrangement of axles, and the heating-surface in proportion. Referring to the boiler under consideration, the back-plate, throat-plate, dome, and tube-plate, as well as the safety-valve seating, are all flanged on moulds by hydraulic pressure.

The old method of flanging by hand is still in use, but there are several objections to it; among others, waste of time, increased cost, and the necessity for heating the plates several times before the flanging is complete, resulting in deterioration of the metal. In this boiler, as before observed, cast-steel girder-stays are employed for supporting the crown of the firebox to the shell. When the firebox expands vertically, these stays slide up the hoops, which are held by bolts to the angle-irons riveted to the crown of the shell. Thus the slung stays support no load in ordinary working conditions. The cost of these stays is considerably less than that of forged-iron stays. Mr. D. S. Smart, in the course of dealing with "The Modern Practice in the Construction of Steam Boilers,"* a few years ago, observed: "Girder-stays have, until recently, been universally employed in the strengthening of firebox crowns of the locomotive type of boiler; but direct stays between the crown of the firebox casing and the firebox crown are now to a great extent taking their place. Girder-stays are decidedly objectionable in obstructing the circulation of the water, and in tending to cause overheating through the narrow water-spaces between them, and the crowns becoming choked with deposit; also on account of the severe stress thrown upon the plates on which they rest." There are, the author believes, only two important railways in England which use direct stays. The objection to the limited water-space under the girder-stays holds good, for a 2in. water-space between the underside of the girder and the crown of the firebox is hardly sufficient, considering the rapid circulation of the water in this, the hottest part of the boiler. There appears to be no objection to raising the underside of the girder-stay an inch or so higher, thus ensuring free circulation. It is recognised that girder-stays allow uniform expansion of the firebox without throwing undue stress on the tubes and side-stays.

Referring to Fig. 2, the longitudinal stress in the boiler is relieved by through-stays. This, the author believes, is the best way to stay high-pressure boilers longitudinally. The stays are easily taken out when it is required to examine the boiler, all that is necessary being to remove the nuts at the smokebox tube-plate, and slack the stays from the back of the firebox shell. Further, these stays prevent any unnecessary shearing-stress being thrown on the circumferential rows of rivets in the boiler barrel. The brass tubes in this boiler are ferruled at the firebox tube-plate and swelled out at the smokebox tube-plate. The ferruling of small tubes is rather objectionable, on account of the reduction of flue area at the entrance of the tubes; also on account of the tendency of the ferrules to fuse, owing to the thick tube-plate and the limited water-space between the tubes. A very good method of expanding tubes, either steel or brass, is to bead them over with a special mandril. The flat edges of the tubes formed by the beading are forced up against the tube-plate, and are perfectly steamtight. It is advisable to bend the tubes slightly upwards at the centre of the boiler, and thus prevent bending stress from being applied to the tubes when the firebox expands vertically. This also relieves the tubes of tension when the boiler is under pressure. Steel tubes are used in locomotive boilers on several railways, and appear to answer very well where the water is comparatively pure. They are much cheaper than brass tubes, and are easily cleaned and put back into the boiler, the ends being well annealed.

(To be continued.)

* Minutes of Proceedings Inst. C.E., vol. lxxx. p. 112.

The Marine Boiler, Past and Present.

(Concluded from page 52.)

FORCED DRAUGHT is a subject of much interest to us as foremen boilermakers, seeing that it is coming more into use every day for the marine boiler. The advantage which may be derived from the use of a fan, or some other mechanical means, to supply the amount of air required for the combustion of ordinary fuel, as well as for economising the weight and space of machinery, is found in the application of forced draught. In ordinary high-pressure boilers there are various methods of doing this. One of the most common methods in the past was the use of steam jets in the funnel to give an increased rate of combustion. It was found to be wasteful of steam. It is stated on good authority, that where the rate of combustion was from 40 to 50 per cent., the gain in indicated horse-power was only 15 per cent. All boilers where furnaces are supplied with air by mechanical means, or by means additional to the natural draught, I think may be called forced draught. There are several methods by which the principle of forced combustion may be carried out. Among the methods most commonly adopted is one for supplying air under a pressure to the ash-pits of the furnaces. This is an old way of applying forced draught, and, I believe, was first used in America, where at the present time it may be found in operation on some of the river steamers. The principle most commonly used in America is what is called Main's hot blast. In connection with this there are a series of pipes, as you see by the drawing on the table before you, leading the air to an air-heater, which is fitted round the base of the funnel. After the air is heated it is sent from the air-heater to the furnaces and ashpits. The air pressure, by water column test, before entering the air-heater is 3in., and at the furnaces and ashpits ⅝in. The value of drawing out the foul air and the gases that accumulate in the holds, bunkers, and other parts of the ship, will, I have no doubt, be considered by all of us to be beneficial to the health of those on board. A constant current of pure air is kept circulating through the ship, thus stopping all condensation in the holds. The usual ventilators send a constant supply of pure air through the holds, and a Root's blower, which is fitted in the engine-room, draws the impure air out of the holds, and passes it through the heater on to the furnaces. Another way of increasing the boiler power by rapid combustion is that known as the closed stoke-hole system, which has been so extensively used in our own and other Government ships. It is difficult to understand why preference should be given to this method over others which have proved themselves to be a greater success than the closed stoke-hole system. The cleaning of the fires and the drawing of the ashpits must be to us difficult to imagine. There cannot be worse treatment to a boiler than to permit a volume of cold air under pressure to rush into the back end of a hot boiler. This is the cause, no doubt, of so many of Her Majesty's ships turning out (one might say) almost complete failures, owing to its causing the tubes to leak at the back ends, and, in some cases, the corners of the combustion chamber to crack. The method of forced draught which is most commonly used in the merchant service is what is known as Howden's forced draught. I have seen several steamers fitted with this system. There were two steamers altered from the ordinary compound type of engines and boilers, with natural draught, to that of triple expansion, or tri-compound, with Howden's forced draught, just to show some of the advantages of this system. The two steamers, previous to their alterations, were fitted with three double-ended boilers, six furnaces in each boiler, two stoke-holes, and nine furnaces in each stoke-hole. The steamers, when loaded, had an average draught of 23ft.; cargo and bunker coal, 3500 tons; average speed, 10 knots; consumption of coal per day, 29 to 30 tons. They were fitted with two single-ended boilers 12ft. long by 15ft. diameter (the old boilers being 18ft long by 12ft. diameter), three of Purves' ribbed furnaces in each boiler, making only one stoke-hole with six fires, giving an increased space for cargo of 530 tons, and a reduction in the weight of machinery of 113 tons. The saving of space is one of the advantages claimed for forced draught. The steamer, when loaded to her former water draught (23ft.) and carrying 530 tons more cargo, at an average speed of 10 knots, her coal consumption 24 to 25 tons per day, showed a saving of coal of from four to five tons per day. The "City of New York" was, I believe, the first steamer that worked at sea with forced draught, and continues to do so with every satisfaction up to the present time. All furnace and ashpit doors, smoke box doors, and uptake, are fitted air-tight for Howden's system of forced draught. Running across the front of the boilers, immediately above the line of boiler tubes, is a casing, about 2ft. 6in. square, with air tubes 2¼in. in diameter, running vertically through the square casing inside the uptake. By this arrangement the gases pass through them on their way to the funnel. From this air casing, leading to the engine-room, there is fitted another casing, about 3ft. 6in. square, and at the end of this casing in the engine-room is attached an ordinary fan and engine. The air, under a pressure of 3in. water column test, passes from the fan along the 3ft. 6in. passage way leading to the vertical air tubes in the uptake. The air passes round the outside of the vertical tubes, and the smoke and gases pass through the inside of the tubes, and by this means the gases, which hitherto passed up the funnel, and were always considered a great loss, are now used in heating the air before it passes down the front of the boilers. The furnace fronts are of peculiar construction. They are fitted with three separate passage-ways, two leading to the ashpits, the other leading to the top of the firebars. When the fires are under way, and the forced draught in use at ⅝in. pressure, it is necessary to close the two valves leading to the ashpits before opening the furnace door. By opening the furnace door—the ashpit valves not being shut—there is a possibility of the flame rushing out of the furnace door and causing an accident, there being no need to shut the valve leading to the top of the firegrate. In the boiler tubes there are what are called retarders made of strips of steel 2¼in. by ⅛in., twisted in spiral form. Their object is to prevent the gases passing through the tubes too rapidly. These tubes are cleaned by steam, by means of a patent valve and a flexible tube fitted with a handle. Upon pressing the valve on the front of the tube hole the soot is blown back into the combustion chamber. In many cases the retarders were also blown back into the combustion chambers. To prevent this I split the ends of the retarders, fish-tail fashion, as you can see by the small model before you on the table. It creates a great amount of extra labour in taking out all those retarders for the purpose of cleaning tubes with the tube brush in the ordinary way. But without the retarders the consumption would increase 2 tons per day; and if some arrangement could be made to greatly assist in taking out and putting in the retarders, it would not only lessen the labour and expense, but would aid the forced draught considerably.

The rapid accumulation of clinker on the firebars is a source of evil; and any contrivance which can get rid of clinker as soon as it is formed will be a great step in advance, and will enable boilers to be made much smaller than they are at present. The saving of space would not be at the expense of the durability of the boiler or economy of fuel. All the movable bars that have been tried offer no solution of this difficulty, as they seem to be quite unsuitable for high rates of combustion. As regards the durability of boilers with Howden's system, during my experience of the last two years I must say that I have seen nothing to lead me to think that high rates of combustion are harmful to the boilers.

Shipbuilding Notes.

At the commencement of July twenty-four steamers, representing 5280 tons, and forty-three sailing vessels, representing 20,070 tons were in course of construction in Norway.

On the 13th inst. there was launched from the shipyard of Messrs. Cumming and Ellis, Inverkeithing, a sailing barquentine of the following dimensions:—155ft by 27ft. by 11ft.

Messrs. Turnbull and Son, Whitby, launched on the 10th inst. a steel screw-steamer. Her deadweight carrying capacity is estimated at about 3000 tons. The engines are by Messrs. Blair and Co., Stockton-on-Tees.

The Grangemouth Dockyard Company launched on the 10th inst., from their Alloa yard at Kelliebank, one of the largest steel barques ever built in Alloa. She is 310ft. in length, and has a carrying capacity of 2750 tons.

The second-class cruiser "Intrepid" completed her steam trials at Portsmouth on the 8th inst., after having had her boiler tubes ferruled. She developed a mean power of 7486 horses, and realised an average speed of 19·9 knots.

There was launched from the yard of Messrs. Ramage and Ferguson, Leith, on the 9th inst., a steel screw-steamer. The dimensions are:—Length, 225ft.; breadth, 33ft. 3in.; depth, 16ft. 11½in.; gross carrying capacity, 1500 tons.

There was launched from the shipbuilding yard of Messrs. Workman, Clark and Co. Limited, Belfast, on the 9th inst., a large steel screw steamer. The dimensions are:—Length, 400ft.; breadth, 48ft.; depth, 32ft. 8in.; gross registered tonnage, about 5000.

There was launched on the 11th inst. from the West End shipbuilding yard of Messrs Wm. Hamilton and Co., Port-Glasgow, a three-masted steel sailing ship. The dimensions are:—Length, 266ft.; breadth, 44·8ft.; depth of hold, 24·6ft.; 2109 tons register, to carry 3800 tons.

Messrs. David J. Dunlop and Co. launched from Inch Works, Port-Glasgow, on the 5th inst., a screw steamer. She is 230ft. long, 32ft. beam, and 16ft. 6in. moulded depth to main deck. The engines are triple-expansion of about 1500 H.P. The gross tonnage is about 1000 tons.

A steel screw-steamer was launched on the 11th inst., from the yard of Messrs. Edwards' Shipbuilding Company Limited, Howdon-on-Tyne. The dimensions are:—Length over all, 326ft.; breadth extreme, 42ft.; moulded depth, 28½ft. The engines and boilers are by Messrs. Hawthorne, Leslie and Co. Limited, Newcastle-on-Tyne, and are of the triple-expansion type, cylinders 23, 38, and 62, by 42in. stroke.

Messrs. Wood, Skinner and Co. launched on the 9th inst., from their shipyard at Bill Quay-on-Tyne, a steel screw-steamer of the following dimensions:—Length, 268ft.; beam, 36ft. 6in.; depth moulded, 19ft. 3in., with a deadweight carrying capacity of 2600 tons on a light draught. The vessel is to be fitted with engines of the triple-expansion type by the North-Eastern Marine Engineering Company Limited, Wallsend-on-Tyne, the cylinders being 19, 31⅓, and 51½in., with a stroke of 36in., capable of propelling the ship at a speed of 9½ knots loaded.

Utilisation of Water Power.

(*Concluded from page* 58.)

Hydraulic Mains.—Bramah, in 1796, by an ingenious contrivance, first gave the principle of the hydrostatic press a practical application. He saw that the incompressibility of water formed a favourable medium for the transmission of force, and it was utilised by him by means of a small pump at a high pressure, acting with the least possible loss by friction on a large piston or ram, thus obviating the necessity of gearing. It was not, however, until 50 years after this that water pressure was utilised in other directions for power purposes. In 1846 Lord Armstrong erected the first hydraulic crane at Newcastle Quay, since which date numerous and valuable machines driven by water pressure have been invented. Lord Armstrong, Mr. Ellington, and Prof. H. Robinson were the first to inaugurate the laying of high-pressure water mains in towns for the purpose of providing power for the use of private consumers, without their having to separately erect the generating plant necessary for causing the required artificial head. The author here begs to acknowledge that much of the information contained in this paper is obtained from the experience of these gentlemen, and also from Prof. Unwin. Hydraulic mains have been laid in Hull, London, Birmingham, and other towns, side by side with gas and water pipes. The most economical pressure to use appears to be about 800lb. to the square inch, which is generated by steam engines pumping into the mains and accumulators.

The accumulator, which fulfils most important functions in connection with the mains, may be described as a cylinder in which a ram works, the top of which is weighted to the required pressure. This weight, which is raised as the piston ascends, of necessity gives the water an artificial head, equal to a column of water of great height. If, for instance, the pressure within the main is 800lb. to the square inch, it is the equivalent of a column 1848ft. high, which, for practical purposes, in most instances it would be almost impossible to obtain. Besides serving to produce an artificial head, the accumulator also stores up the water pumped when it is in excess of the water consumed; and, in fact, performs in the hydraulic system the functions of the fly-wheel of a steam engine. As the consumption of water by the machines connected with the main falls below the supply of water pumped by the engine, the ram rises and stores in the cylinder the excess, until the ram has risen to the top of its stroke, when it cuts off the steam from the engine by closing the throttle-valve. On the other hand, when the consumption of water by the machine is greater than is being supplied at the time by the engine, the ram falls and supplies the deficiency, at the same time opening the steam-throttle valve, by which the full power of the engine is brought into operation. The accumulator thus acts as a reservoir of power and as a conservator of its distribution.

Prof. Unwin writes concerning the power to be obtained from hydraulic mains, "The pressure is too great to be conveniently applied in a turbine, and the pressure engine in its ordinary form is too extravagant in its consumption of water for ordinary power purposes."

Without going into the relative advantages of the various types of pressure engines, we may mention that the Hastie, the Brotherhood, and the Pelton are being used in London for power purposes. These machines have an efficiency of from 80 to 85 per cent. The Chester Hydraulic Engineering Company (who constructed the hydraulic machinery used by the London and Hull Hydraulic Power Companies) state that they have recently fixed in London, besides a large number of Brotherhood hydraulic engines, several Pelton motors. This is a high-speed motor, and has a little greater efficiency than the Brotherhood. For slow driving, or for machines which require to be frequently stopped and started, the Brotherhood engine is the best; but for high-speed machinery, such as for driving dynamos, the Pelton is recommended, as there is no necessity for intermediate gearing, and the full power of the motor is utilised.

Possibly, as motive power is not a necessity to people in the same sense as drinking water is, it will be some time before municipalities undertake the installation of power mains themselves; but that it may some day be the duty of municipal engineers to lay them down is not unlikely.

Application of Power.—In many directions there is undoubtedly a field for the utilisation of water-power in conjunction with that of electricity. A great deal of water runs away year after year, unused, to the sea, which might be the motive power for driving electromotors and for producing electric light. Particularly is this the case in small towns and villages, which by the introduction of these facilities might find it possible to carry on many industries with greater advantage than at present. This would be a desideratum not to be despised, as it is now the object of statesmen, if possible, to prevent people from crowding into the larger towns, seeking the employment which to a considerable extent is dependent upon efficient machinery. As a body of men having at heart the physical welfare of the inhabitants of our towns, we should welcome the results foreshadowed here as a most desirable thing.

Some public authorities which are in the unfortunate position of not owning the gas-works have frequent and reasonable cause for complaint with respect to both the efficiency and the price of the light supplied to the street lamps.

Where the conditions of the locality are favourable for the utilisation of water for driving dynamos for producing electric light, the public authority is possessed of a strong lever for the reduction of its gas bill, if it does not inaugurate electric lighting. A case in point occurred not long ago at Carlow. The municipal authorities quarrelled with the gas company and determined to discontinue gas lighting, and to start electric lighting instead. Carlow being situated at the junction of the rivers Barrow and Burren, plenty of water power was available. A disused corn mill, five miles away from the town, was converted into a dynamo-room, the old waterwheel of the mill doing the necessary work. It is, however, intended to erect a turbine in the future. The wires conveying the current are carried overhead on poles to the town.

Efforts are being made in the Alpine countries to use the masses of water which run wildly down the mountain sides as a means of producing electricity. Turbines placed at the foot of the falls are turned by the force of the water, and a dynamo is attached to the turbine and driven by belting. In this way no fewer than twelve towns in Switzerland are fixing up electrical apparatus for lighting and power purposes. In places where falling water abounds, electrical energy can be produced cheaply. As an illustration, it may be mentioned that an electrical company has been formed at the village of Faide, on the Gothard Railway, a place numbering 1000 inhabitants. By means of iron pipes a small supply of water is obtained from the neighbouring Pinmogna torrent, which drives below a small high-pressure turbine, which in turn drives a dynamo supplying 360 glow lamps. The whole cost is under £2000, which sum is divided into shares of £15, the owners forming the company. In this manner, in addition to the streets and railway station, the peasants and working-men have their houses supplied very cheaply with the electric light, which is elsewhere regarded as a luxury, but which Prof. Preece regards as a great sanitary agent.

When Mr. W. B. Bryan, C.E., was the borough engineer of Blackburn, he had to deal with the sewage of a district which had been newly incorporated by an extension of the borough boundaries, and lying 24ft. below the sewage outfall. He therefore designed a pumping station, the engines to be actuated by pressure from the town mains. The pressure in the mains was 125lb. to the square inch. The engines worked automatically, and were capable of raising 1,000,000gals. in 24 hours 24ft. high. Mr. Baldwin Latham in a number of cases has been using high-pressure water for transmitting power for automatically pumping sewage. At Friern Barnet, for instance, he is transmitting power from the sewage works to a point a mile distant, and lifting the sewage of an isolated district 55ft. high into the gravitation sewers. Sewage is raised at Brentwood by means of a waterwheel. Small motors driven by sewage are used for working lime-mixers, etc.

In connection with power mains, a small jet of high-pressure water injected into a larger jet from the waterworks mains intensifies the pressure of the latter in the delivery hose, and also increases the quantity. A pressure of 40lb. to the square inch in a water main will throw the water issuing from a hose to the height of from 40ft. to 50ft.; but if water is turned on through a ⅛in. opening from the high-pressure main of 750lb., the water will rise to a height of from 90ft. to 100ft. through the atmosphere. Sir E. M. Shaw says this result would be very satisfactory, the pressure being as great as from a fire engine.

Another application of water power was made in the iron subway under the Thames just below Kingston Bridge. The subway was constructed of cast-iron plates bolted together in segments, forming rings 18in. deep, the diameter being 9ft. The method employed in driving the tunnel and fixing the plates was similar to that adopted in the construction of the City and South London Electric Railway. An iron shield of slightly larger diameter than the subway itself was forced forward into the clay by powerful hydraulic jacks for a distance of about 18in., sufficient to insert one ring of the cast-iron plates. The Tower Bridge is provided with two steam pumping engines for hydraulic machinery, each 360 H.P., eight large hydraulic engines, six accumulators, and four hydraulic lifts in towers for passengers. The hydraulic forging presses at modern engineering works far exceed the Nasmyth hammer, which was once considered to give wonderful results. These presses are of 4000 tons, and are worked by 200 H.P. pumping engines, and commanded by travelling cranes capable of lifting 150 tons. Altogether, hydraulic power is very serviceable in the working of ponderous machine tools, as it is also in the working of cranes, etc. We are indebted to water power in no small degree for the cleanly and noiseless lifts which are the comfort of lofty houses and flats.

No doubt the efficient utilisation of water power presents many difficulties which it is the duty and privilege of engineers to overcome. Surely there is a splendid field in many directions for the employment of such a well-understood natural power as that of water.

Leeds Association of Engineers.

THE annual summer excursion of the Leeds Association of Engineers took place on Wednesday, the 3rd. inst., the members visiting the works of Messrs. Walker and Hall and Messrs. Joseph Rodgers and Sons Limited, Sheffield. In the morning they were conducted round the former establishment by Mr. C. H. Bingham. This is said to be one of the largest electro-plating works in the world, over 700 hands being constantly employed. The members were shown the various processes by which the rough metal was transformed into elaborate pieces of plate. A great many of the parts required for the making up of the various articles are struck into form by stamps in steel dies, of which there are over 100 tons on the works. The heads of the stamps are raised by straps laid over revolving pulleys. The workman applies pressure on the strap to raise the stamp, which, on being released, falls by its own weight. The heavier stamps are drawn up by means of a strap passing over a loose pulley and attached to a steam cylinder.

In the spinning-shop, teapots and other articles are shaped, under the practised eye of the workman, while rapidly rotating. This branch of work is very interesting, as shapes start into existence from a flat disc of metal, controlled almost entirely by the skill of the workman. After articles are stamped and shaped they are put together by the silversmiths, who do the work so neatly that, after finishing, the joints cannot be detected. The goods are then forwarded to the buffing department, and levelled by means of rotating leather discs and the application of sand and oil. This prepares them for electro-plating. Before being plated, however, they are freed from grease, etc., by means of boiling potash leys, and scoured by wire brushes driven by steam. The plating and gilding rooms were especially interesting. At one end of these rooms, George Walker, the founder of the firm, first commenced business. It was he who assisted the inventor, Dr. Wright, surgeon, of Attercliffe (now a part of Sheffield). George Walker was the first man who plated any goods for use; the first were two teaspoons and a saltspoon. The small vat in which he plated these is to be seen in the large showroom, and is valued by the firm at more than its weight in gold. The oldest proprietor remembers the time when, instead of dynamos, which are now used to produce the electrical current which drives the silver on to the goods, cellars full of "Daniel's batteries" were used, and a man in rags (so great was the destruction of his clothing by the acids) worked the batteries. After plating the goods are passed on to the finishing and polishing rooms, on leaving which they are ready for sale or exhibition.

In the afternoon the members visited the cutlery works of Messrs. Joseph Rodgers and Sons Limited, where they saw the forging of steel blades from best double shear steel. This is done by hand, as the continued hammering necessitated in drawing out the material greatly improves its quality, which is not the case in the cheaper tripped or rolled processes often used for common material. The blades are afterwards finished by grinding, glazing, and polishing. The ivory stores were also inspected, and the various shops where ivory, stag-horn, etc., is sawn up and shaped into handles, and where the blades are fitted into them. About £20,000 worth of ivory are used in these works in one year, costing about £65 a cwt. Both these houses have extensive showrooms, where they keep some splendid exhibition specimens of their work. The party afterwards dined at the Wharncliffe Hotel, when the president (Mr. R. Lupton) took the chair, and votes of thanks were passed to the firms mentioned for their kindness on the occasion.

Trade Notes.

The waterworks at Overton, Alexandria, have just been enlarged at a cost of £1500.

The electrical works at Cambrai, France, after having been closed for a year, are about to be reopened.

The directors of the Sheffield Forge and Rolling Mills Company Limited announce a dividend of 8s. per share.

The directors of the Darlington Wagon and Engineering Company Limited have declared a dividend of 8s. per share.

Messrs. De Bergue and Co., of Manchester, are supplying the ironwork of the new bridge to be constructed at Ripon.

Messrs. Fowler and Co., of Leeds, have received an order from the Felling Local Board for a 15-ton steam roller, to cost £500.

Messrs. Lowdon Brothers, Dundee, have secured an order to install with electric light the works of Messrs. A. and J. Macnaughton, Pitlochry.

The United Asbestos Company have been awarded the contract for the supply of all asbestos goods required in the Royal Navy during the ensuing twelve months.

The Fire Appliances Manufacturing Company have received an order from the Colwyn and Colwyn Bay Local Board for the supply of a steam fire-engine, hose, etc.

Messrs. Oakes and Co., of the Wenlock Ironworks, have contracted for the supply of iron pipes required by the Staffordshire County Council for a period of one year.

Messrs. H. E. Gordon Limited, London, have secured the contract for the whole of the machinery required by the Scottish House-to-House Electricity Company, Coatbridge.

Messrs. Hutson and Corbett, Kelvinhaugh Engine Works, Glasgow, have received orders to supply new boilers for a number of steamers, and also to overhaul their machinery.

Messrs. J. H. Wilson and Co., of Liverpool, have constructed two 40-ton floating steam cranes for use at the new harbour works at Odessa and Theodosia, on the Black Sea.

Messrs. Woodhouse and Rawson United Limited, London, have secured the contract for the supply of the condensing plant necessary for the electric-light installation for the Bristol City Council.

Messrs. Hill and Smith, Brierley Hill Ironworks, Staffordshire, have contracted to supply the Liverpool Corporation with the ironwork for a 12-cell refuse destructor for £430, and also the roofing contract for £450.

The directors of Muntz's Metal Company Limited have resolved to declare an interim dividend for the half-year ended June 30 of 5 per cent. per annum on the preference and 10 per cent. on the ordinary shares.

The Chatham, Rochester, and District Electric Lighting Company Limited have accepted the tender of Messrs. Johnson and Phillips for the laying of underground mains in Chatham on the Brooks system of oil insulation.

The new bridge which is being erected across the Clyde at Cambuslang is expected to cost £10,000. The contractors for the work are Messrs. Paton and Thomson and Messrs. Alex. Findlay and Co., Motherwell. The last-named firm are doing the steel work of the bridge.

Mr. W. H. Baraclough, consulting mechanical engineer and patent agent, Triangle Chambers, Martineau-street, Birmingham, without solicitation, writes:—"I have pleasure in stating I have received more inquiries from my advertisement in THE MECHANICAL WORLD than from any I have running."

The attention of "Mechanical World" readers is directed to the sale by auction, by Messrs. Horne, Son and Eversfield, a notice of which appears in our advertising columns, of the machinery, stock, and plant of a timber merchant and sawyer. The place of sale, Bexley Heath, is only a short distance from Charing Cross Station.

Wheel cutter in metal only. Every description of gearing. R. CHIDLAW, 43, City-road, Manchester.

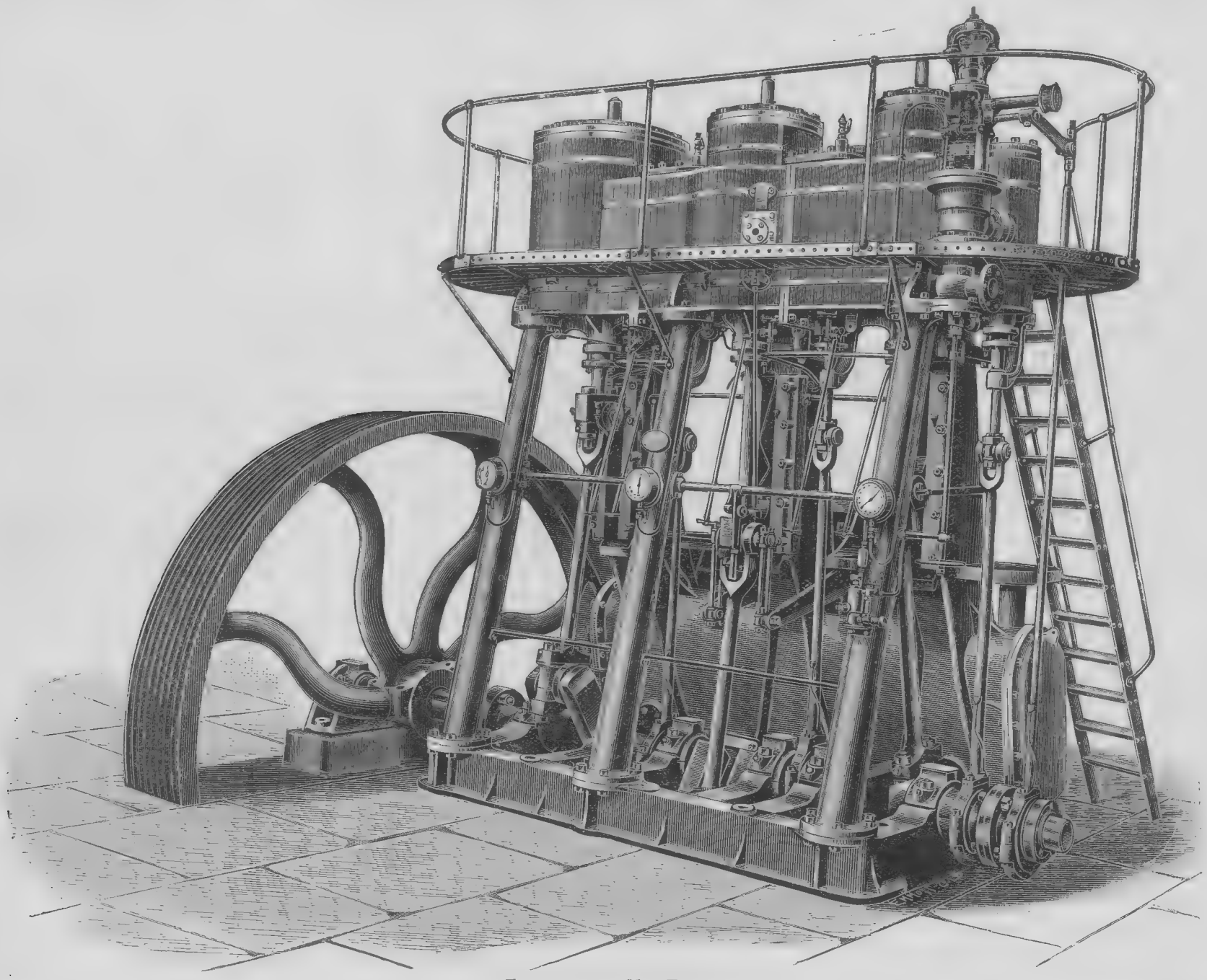
Having regard to the enormous circulation of THE MECHANICAL WORLD, the Editor suggests that it is by far the best medium for the insertion of every kind of "Wanted" advertisement, and the price is only one halfpenny per word. The Editor will be glad if MECHANICAL WORLD readers will kindly bear this in mind as occasion arises.

Triple-expansion Mill Engines.

THAT the economical generation of power for mill-driving purposes implies the use of high-pressure steam has long ceased to be a debatable point, says THE TEXTILE MANUFACTURER; but as to the most efficient type of engine for the purpose opinion is still to some extent divided. Until a comparatively recent period the horizontal compound engine was held to satisfy all the requirements of the mill-owner; but as competition became keener the highest economy in power generation was found to be absolutely indispensable, and as a consequence the use of still higher steam pressures with triple or quadruple-expansion engines is rapidly becoming general. With the adoption of the latter types for mill driving, the once generally-used horizontal engine has given place to the vertical type so long and successfully employed for marine purposes. The arrangement has many advantages over the horizontal form, as less room is occupied, the cost of foundations is comparatively small, and at the same time, owing to the even distribution of the reciprocating weights, exceedingly steady turning is obtained—a point of the utmost importance in the driving of spinning mills.

We have in previous issues of this journal illustrated and described several forms of recent types of engines, and we have now pleasure in directing attention to a fine set of triple-expansion engines shown in the accompanying illustration, and constructed by Messrs. Westgarth, English and Co., engineers, of Middlesbrough-on-Tees. The engines, which are intended for a mill abroad, are to indicate 250H.P. when running at 90 revolutions per minute and with steam at 150lb. per square inch. The cylinders are 11½in., 18in., and 30in. in diameter respectively, with a stroke of 30in. The high-pressure cylinder is fitted with a piston valve, and the engines are controlled by the "Proell" automatic expansion gear. The fly-wheel, which is 12ft. in diameter, is grooved for eight 2in. ropes; the bearings are lined with white metal, and especially large wearing surfaces are provided. The surface condenser is fitted with brass tubes and tube plates, while all the pump fittings are of brass.

We are informed that Messrs. Westgarth, English and Co. have supplied with these engines two boilers of their marine type. They are constructed of Siemens steel, for a working pressure of 150lb., and tested by hydraulic pressure to 300lb. per square inch. The boilers are so arranged that, together with the smokeboxes, they are entirely self-contained. No foundations or flues are required, as the boilers are erected upon a level floor. It may be of interest to state that the engines illustrated were run under steam at full speed at the works of the makers without any foundations other than the wood chocks upon which they had been erected; but no rocking or oscillation was observable, thus affording very conclusive evidence of the steadiness with which these engines run. It will be seen from the illustration that the general arrangement of the engines is such as to render all parts easy of access, the pumps and fittings being all above the floor level. We think it will be evident that much care has been bestowed upon the general design of these engines, as well as upon several important details which too often escape notice. The engines are exceedingly neat and compact, and will, we have no doubt, prove in every respect satisfactory in operation.



TRIPLE-EXPANSION MILL ENGINES.

Some Points for the Electrical Engineer.

(*Concluded from page* 41.)

Station Construction.—In station construction there has been no settled design, therefore the promoters have generally built as they saw fit, occasionally following suggestions of the agent. Of course many plants are located in buildings already up, in which case the machinery had to be made to fit.

In many of those built specially for the work, no attention has been paid to designing for a low insurance rate, and brick stations are found sheathed all over the inside with pine, the one thing that insurance inspectors always criticise. A couple of coatings of whitewash or paint would have been much cheaper and safer.

When stations have been remodelled very little improvement has been made in the smaller ones, but those in large cities have generally taken advantage of all the improvements to date, if not too strongly attached to some parent company.

Motive Power.—The selection of motive power has of course been governed by local conditions; in the northern and north-western parts of New York State water power is abundant, and is largely used as motive power for stations, but almost invariably with steam reserve.

Water power alone has been found very difficult to govern for uniform speed, and some of the devices used for that purpose are, to say the least, ingenious.

When the load is large enough to use part steam there is no trouble whatever, as the wheel takes a steady load and the engine does the governing.

Plants are sometimes placed a long way from the work in order to take advantage of water power, and in some cases it seems as if all else had been sacrificed to that one point.

Of engines there is no end to the different design, style, and size used. Some use high speed, belted direct to dynamos; others slow speed, belted to countershafts; some simple non-condensing, where compound condensing would be decidedly the best.

I know of at least three plants located in waterworks pumping stations using high-speed simple non-condensing engines on a practically steady load, all of which have been erected during the past three or four years.

Two stations I remember have an all-night and every-night load of arc lights, and are situated on a lake shore, which run high-speed simple non condensing engines. To offset this there is one station that deserves mention, as it embodies many points of value. The building is substantial, of brick, two storeys high, and on a river bank. The boilers are very efficient and well set, the engine is a moderate speed compound condensing, with shaft extended for three dynamo pulleys and one for the power condenser. There is a heater between the exhaust and condenser, and a power pump attached to one side of the condenser. The flow to the boilers is governed by a by-pass valve, as the pump is of course in motion all the time the engine is running. This station has only an arc load and runs all night; it was built entirely under the supervision of a local mechanical engineer, with the exception of connecting the lines and dynamo terminals to the switchboard, and would, I think, be hard to beat for results.

Arrangement of Machinery. — The arrangement of machinery is as diverse as the style of motive power; when direct belting is used the arrangement is generally simple and plain, but oftentimes so crowded as to be very inconvenient.

There seems no end to the arrangement of shafting; some have a line shaft through the middle of the dynamo-room, and belt both ways to dynamos; others a shaft on either side of the room, belting to dynamos in the centre; others the shaft under the floor, belting up to dynamos, and occasionally to engines also; others have the shafting overhead; in fact, there is no end to the styles, some good and some bad. In most cases friction clutches are used with shafting for stopping individual dynamos, and some few may use loose pulleys on independent sleeves for the same purpose.

The length of belt centres varies greatly, some apparently thinking that if long belts are better than short, very long ones must be much the best.

The improvement in switchboards seems to me more marked than in any other one department, which is probably owing to the pressure of insurance men, who look at the switchboard as the most dangerous fire risk of all.

Line Construction.—In line construction I cannot see that any very marked improvement has been made, excepting, in some cases, the substitution of larger and better poles for the older ones.

The use of black covered wire in place of white has, perhaps, made the lines a trifle less conspicuous; but that is about all. The lines still have the apparent aimlessness of direction mentioned by Professor Thomson at Buffalo.

People in the larger interior cities are already agitating the question of underground wires, and it seems probable that unless something is done soon by the companies themselves to rid the streets of the more conspicuous of these wires, there will be very costly trouble for them to contend with.

It can no longer be denied that wires are working well every day in subways, and the only valid argument against them is extreme cost. Nevertheless, when the general public learns this fact, cost will have little to do with the argument.

In many places wires can be removed from the main streets to alleys at the back of the shops, and the extra cost will be decidedly cheaper than underground work. In such few places as have already done this wires are inconspicuous and the underground question is never raised.

In street lighting the favourite method is the cable suspension across the street. Where the work is neatly done this serves very well, but it would be difficult to find a more unsightly thing than some of the lamps so suspended.

Considerable trouble is occasioned in the above method by breakage of the wires at the joint with the line and at the crossbar over the hood. There is no apparent reason why twin or duplex wires should not be more used for this purpose, instead of the kinked and straggly single wires.

It seems to me that if some action was taken by a non-partisan association like this institute, an advance towards better engineering might be made, if a few general laws could be suggested to be followed in laying out the different parts of a lighting station. Perhaps it may be said that much of the above work should more properly come before the National Electric Light Association, but as many of that society are members of this institute, I feel sure they would individually appreciate its backing in the future when the time comes for enlargement and they have need of combined expert opinion.

The "Capitaine" Oil Engine.

We recently had the pleasure of inspecting in operation a novel form of oil engine known as the "Capitaine," and now being placed upon the market by Mr. Leopold Tolch, 71, Lord-street, and 38, Byrom-street, Liverpool. Fig. 1 gives a general

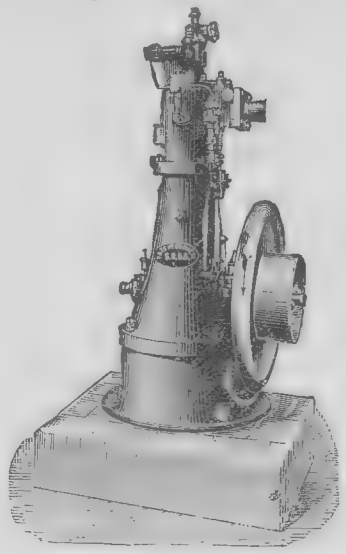


Fig. 1.

view, Fig. 2 an end view, and Fig. 3 a sectional elevation. As will be seen, the engine is of the vertical type, the cylinder being surmounted by a conical bonnet or cover, as shown. The piston is of the trunk form usually employed in gas and oil engines, but in this case a substantial crosshead and guides are provided, so that undue wear of the body of the piston and of the cylinder is avoided. The cylinder is water jacketed as usual, F being the inlet for the cooling water and H the outlet. D is a burner, the flame of which is fed with oil from the lamp E, and by means of which the gas generator is heated. The latter is shown immediately above the burner in Fig. 3, and consists of a cylindrical nozzle piece having cast on the outside a series of flanges, as shown, for the purpose of absorbing the heat. By means of a small pump fixed to the side of the engine, and shown on the left hand in Fig. 2, the supply of petroleum is forced from the storage tank through the spraying valve C, and passing through the heated vapouriser is converted into gas. B is a spring-controlled non-return or inlet air valve, which admits the necessary air to form the explosive mixture, and J is the exhaust valve, which is positively operated by the eccentric gear, as shown in Fig. 2. This consists of an ingenious arrangement by which the exhaust valve is normally opened at every second revolution of the engine. This is effected by a neat system of linkage as shown in the end elevation. The eccentric rod is jointed near the lower end, the joint pin being connected to a swinging link as shown. The other end of this link is coupled to a crank pin set in a spur wheel, which latter engages with a wheel of one-half the size fixed on the engine crank shaft. The effect of this combination is to vary the virtual length of the eccentric rod during successive revolutions of the crank shaft. Thus, when in the position shown in Fig. 2, the eccentric rod is rising, and as the pin on the large spur wheel is also moving upwards, the coupling link will move upward approximately parallel to itself and the exhaust valve will be opened. When, however, the eccentric next assumes the position shown, the crank pin on the large spur wheel will have moved through 180°, drawing the joint-pin of the eccentric rod considerably to the left, and thus virtually shortening the eccentric rod so that the exhaust valve is not operated. It will be observed that the eccentric rod actuates the exhaust valve spindle through the medium of a bell-crank lever pivoted to the side of the engine, and operates the petroleum pump by a connection at the left hand, as shown. The depending arm of this lever is formed with a claw or hook which can engage with a detent on top of the governor rod, as indicated. The governing arrangement is shown in Fig. 3. Two balls K carried on studs inside the driving pulley are connected together by spiral springs, and by means of the bell cranks shown operate a sliding collar on the crank shaft. This sliding collar again, by a bell-crank lever, actuates a vertical rod which at its upper end carries a detent. When the speed of the engine is increased, the governor balls inside the pulley fly apart, and through their levers and rods move the sliding collar, which again lowers the vertical rod and causes its detent to engage with the bell-crank lever, which is lifted up and down by the eccentric. The bell-crank lever, thus arrested, holds up the pump rod and keeps open the exhaust valve, so there is no oil supplied to the vapouriser, and consequently no explosion takes place until, through this speed falling, the governor balls come together and the detent disengages the bell-crank lever. As long as the bell-crank lever is arrested—that is, when the engine is not taking in gas—the whole of the valves are quite motionless, thereby materially reducing friction, wear and tear and back pressure on the piston. Having now described the structural arrangement, we may now refer to the working operation of the motor. When the first down stroke of the piston occurs the vapourised oil enters the upper part of the cylinder, and follows the piston in its descent. Air then enters through the top air valve; but the mixture of the two is not effected until the up stroke of the piston, when the charge is compressed into the heated cylinder-cap, whereupon it is exploded and the working stroke performed. During the next up stroke the exhaust valve is opened and the burnt gases escape.

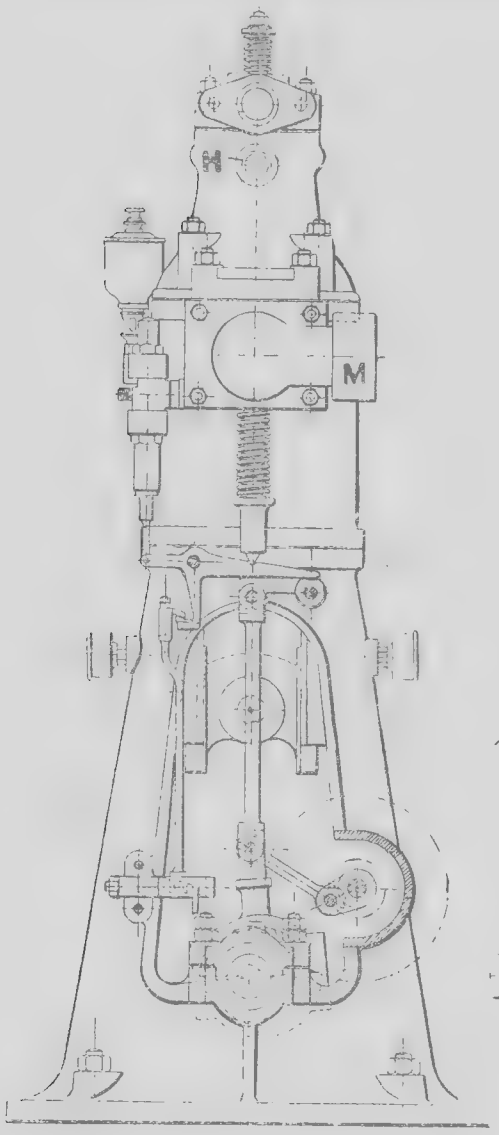
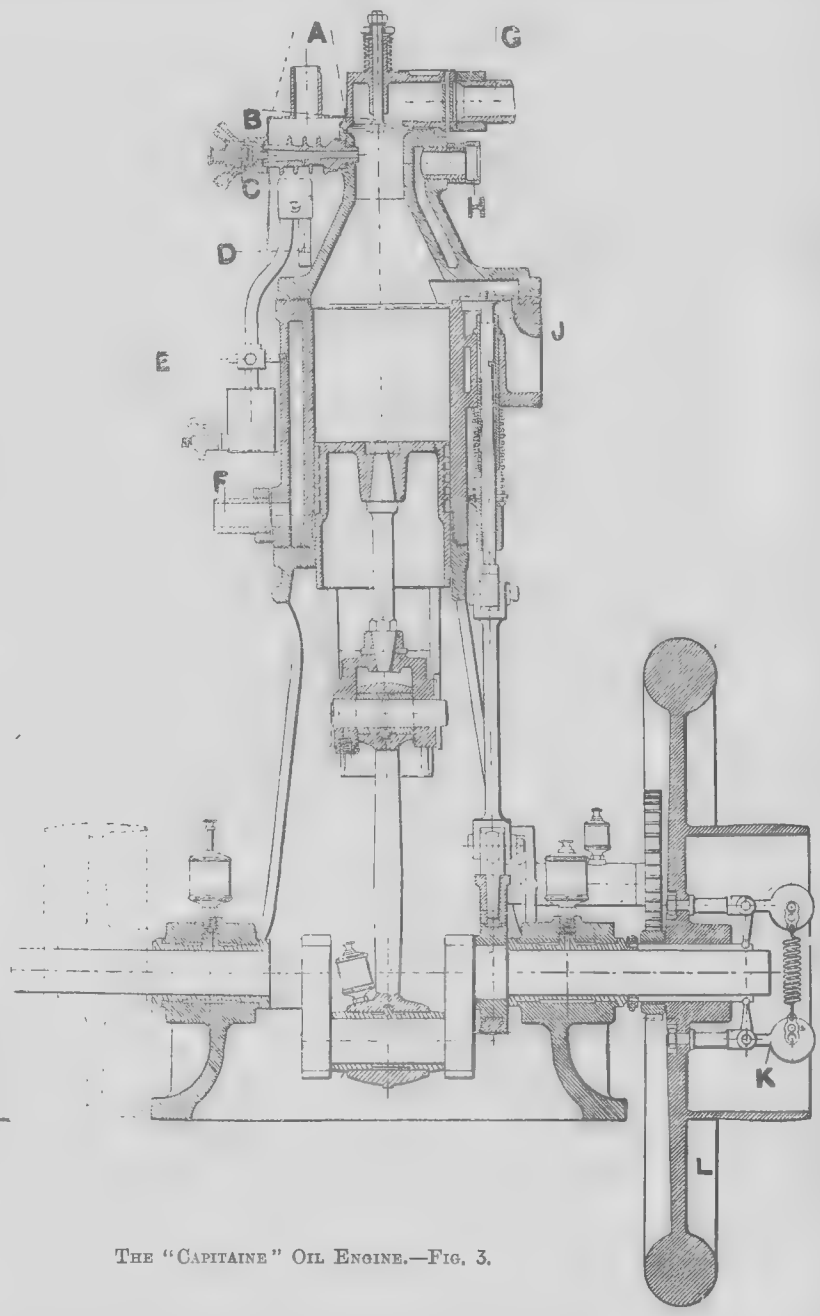


Fig. 2.



The "Capitaine" Oil Engine.—Fig. 3.

One of the principal points in which the "Capitaine" engine differs from ordinary oil engines is the high speed at which it runs. This is, however, amply provided for by employing a short stroke, long bearings, and large and efficiently lubricated wearing surfaces generally. The special disadvantages of high-speed oil engines are, the difficulty of supplying the charge and causing the explosion to occur quickly and at the proper time, which lead to incomplete combustion, both of which tend to considerably decrease the efficiency of a gas or oil engine, causing either the engine to consume an undue quantity of gas or rendering its work unsteady and unreliable. These defects have, it is contended, been completely overcome in this engine. The speed of the 1H.P. engine is 400 revolutions and of the 8H.P. engine 250 revolutions per minute.

We may add that on the occasion of our visit the engine worked smoothly and uniformly, and appeared to bear out in every particular the claims of the makers. Any ordinary mineral oil may be used, the consumption per brake horse-power per hour being about 1 pint in the 1H.P. engine, 0·85 pints in the 2H.P., and about 0·7 pints in the larger sizes. It should be mentioned that very little smell is observable with this engine, and that freedom from vibration was also a noticeable characteristic. We understand that the engine may be seen in operation at 38, Byrom-street, Liverpool, and at 18, Dufferin-street, London.

The British Association.

(*Continued from page* 62.)

In this country Mr. Mair Rumley, following Hirn's method, made a series of experiments on actual engines with great care and accuracy and completeness. All these experiments demonstrated the fact of a large initial condensation of steam on the walls of the cylinder, alike in jacketed and unjacketed engines. This condensed steam is re-evaporated partially during expansion, but mainly during exhaust, and serves as a mere carrier of heat from boiler to condenser, in conditions not permitting its utilisation in producing work. It became clear from Hirn's experiments, if not from the earlier experiments of Isherwood, that for each engine there is a particular ratio of expansion for which the steam expenditure per horse-power is least. Prof. Dery has since deduced from them that the practical condition of securing the greatest efficiency is that the steam at release should be nearly dry. In producing that dryness the jacket has an important influence. In spite of much controversy amongst practical engineers about the use of the jacket, it does not appear that any trustworthy experiment has yet been adduced in which there was an actual loss of efficiency due to the jacket. In the older type of comparatively slow engines it is a rule that the greater the jacket condensation the greater the economy of steam, even when the jacket condensation

approaches 20 per cent. of all the steam used. It appears, however, that as the speed of the engine increases, the influence of the jacket diminishes, so that for any engine there is a limit of speed at which the value of the jacket becomes insignificant.

Among steam engine experiments directed specifically to determine the action of the cylinder walls, those of the late Mr. Willans should be specially mentioned. Mr. Willans's death is to be deplored as a serious loss to the engineering profession. His steam engine experiments, some of them not yet published, are models of what careful experiments should be. They are graduated experiments designed to indicate the effect of changes in each of the practically variable conditions of working. They showed a much greater variation of steam consumption (from 46lb. to 18lb. per indicated horse-power hour) in different conditions of working than, I think, most practical engineers suspected, and this has been made more significant in later experiments on engines working with less than full load. The first series showed that in full load trials the compound was superior to the single engine in practically all the conditions tried, but that the triple was superior to the compound only when certain limits of pressure and speed were passed.

As early as 1878 Prof. Cotterill had shown that the action of a cylinder wall was essentially equivalent to that of a very thin metallic plate, following the temperature of the steam, the exceedingly rapid dissipation of heat from the surface during exhaust especially being due to the evaporation of a film of water initially condensed on its surface. In permanent *régime* the heat received in admission must be equal to that lost after cut-off. In certain conditions it appeared that a tendency would arise to accumulate water on the cylinder surfaces, with the effect of increasing in certain cases the energy of heat dissipation. Recently Prof. Cotterill has been able to carry much further the analysis of the complex action of condensation and re-evaporation in the cylinder, and to discriminate in some degree between the action of the metal and the more ambiguous action of the water film. By discarding the less important actions, Prof. Cotterill has found it possible to state a semi-empirical formula for cylinder condensation in certain restricted cases which very closely agrees with experiments on a wide variety of engines. It is to be hoped that, with the data now accumulating, a considerable practical advance may be made in the clearing up of this complex subject. There are, no doubt, some people who are in the habit of deprecating quantitative investigations of this kind. They are as wise as if they recommended a manufacturer to carry on his business without attending to his account books. Further, the attempt to obtain any clear guidance from experiments on steam engines has proved a hopeless failure without help from the most careful scientific analysis. There is not a fundamental practical question about the thermal action of the steam engine, neither the action of jackets or of expansion or of multiple cylinders, as to which contradictory results has not been arrived at by persons attempting to deduce results from the mass of engine tests without any clear scientific knowledge of the conditions which have affected particular results. In complex questions fundamental principles are essential in disentangling the results. Interpreted by what is already known of thermo-dynamic actions, there are very few trustworthy engine tests which do not fall into a perfectly intelligible order. There is only one known method, not now much used, by which the cylinder condensation can be directly combated. Thirty years ago superheating the steam was adopted with very considerable increase of economy. It is likely that it was thought by the inventor of superheating that an advantage would be gained by increasing the temperature range. If so, his theory was probably a mistaken one, for the cooling action of the cylinder is so great that the steam is reduced to saturation temperature before it has time to do work; but the economy due to superheating was unquestionable, and was very remarkable considering how small a quantity of heat is involved in superheating. The heat appears to diminish the cylinder-wall action so much as almost to render a jacket unnecessary. The plan of superheating was abandoned from purely practical objections, the superheaters then constructed being dangerous. Recently superheating has been tried again at Mulhouse by M. Meunier, and his experiments are interesting because they are at higher pressures than in the older trials and with a compound engine. It appears that even when the superheater was heated by a separate fire there was an economy of steam of 25 to 30 per cent. and an economy of fuel of 20 to 25 per cent., and four boilers with superheating were as efficient as five without it. It may be pointed out as a point of some practical importance that if a trustworthy method of superheating could be found the advantage of the triple over the compound engine would be much diminished. For marine purposes the triple engine is perfectly adapted. But for other purposes it is more costly than the compound engine, and it is less easily arranged to work efficiently with a varying load. There does not seem much prospect of exceeding the efficiency attained already in the best engines, though but few engines are really as efficient as they might be, and there are still plenty of engines so designed that they are exceedingly uneconomical. The very best engines use only from 12lb. to 13lb. of steam per indicated horse-power hour, having an absolute efficiency reckoned on the indicated power of 16 per cent., or reckoned on the effective power 13 per cent. The efficiency, including the loss in the boiler, is only about 9 per cent. But there are internal furnace engines of the gas-engine or oil-engine type in which the thermal efficiency is double this.

In his interesting address to this section in 1878, Mr. Easton expressed the opinion that the question of water-power was one deserving more consideration than it had lately received, and he pointed to the variation of volume of flow of streams as the principal objection to their larger utilisation. Since that time the progress made in systems of transporting and distributing power has given quite a new importance to the question of the utilisation of water-power. There seems to be a probability that in many localities water-power will before long be used on a quite unprecedented scale, and under conditions involving such great convenience and economy that it may involve a quite sensible movement of manufacturers towards districts where water-power is available. If we go back to a period not very distant in the history of the world, to the middle of the last century, we reach the time when textile manufactures began to pass from the condition of purely domestic industries to that of a factory system. The fly-shuttle was introduced in 1750, the spinning-jenny was invented in 1767, and Crompton's machine only began to be generally used in 1787. It was soon found that the new machines were most suitably driven by a rotary motion, and after some attempts to drive them by horses, water-power was generally resorted to. In an interesting pamphlet on the "Rise of the Cotton Trade," by John Kennedy, of Ardwick Hall, written in 1815, it is pointed out that the necessity of locating the mills where water-power was available had the disadvantages of taking them away from the places where skilled workmen were found, and from the markets for the manufactured goods. Nevertheless, Mr. Kennedy states that for some time after Arkwright's first mill was built at Cromford all the principal mills were erected near river falls, no other power than water-power having been found practically useful. "About 1790," says Mr. Kennedy, "Mr. Watt's steam engine began to be understood, and waterfalls became of less value. Instead of carrying the workpeople to the power, it was found preferable to place the power amongst the people." The whole tendency of the conditions created by the use of steam-power has been to concentrate the industrial population in large communities, and to restrict manufacturing operations to large factories. Economy in the production of power, economy in superintendence, the convenience of the subdivision of labour, and the costliness of the machines employed all favoured the growth of large factories. The whole social conditions of manufacturing centres have been profoundly influenced by these two conditions—that coal for raising steam can be easily brought to any place where it is wanted, and that steam-power is more cheaply produced on a large scale than on a small scale. It looks rather, just now, as if facilities for distributing power will to some extent reverse this tendency. Let me first point out that water-power, where it is available, is so much cheaper and more convenient than steam-power that it has never been quite vanquished by steam-power.

I find, from a report by Mr. Weissenbach, that in 1876 70,000H.P. derived from waterfalls was used in manufacturing in Switzerland. According to a census in 1880, it appears that the total steam and water-power employed in manufacturing operations in the United States was 3,400,000H.P. Of this, 2,185,000H.P., or 64 per cent., was derived from steam, and 1,225,000H.P., or 36 per cent., from water. In the manufacture of cotton and woollen goods, of paper and of flour, 760,000H.P. were obtained from water, and 515,000H P. from steam. If statistics could be obtained from other countries, I believe it would be found that a very large amount of water-power is actually made available. The firm of Escher Wyss and Company, of Zurich, have constructed more than 1800 turbines of an aggregate power of 111,460H.P. With a very limited exception, all the water-power at present used is employed in the neighbourhood of the fall where it is generated. If means were available for transporting the power from the site of the fall to localities more convenient for manufactures, there can be no doubt that a much larger amount of water-power would be used, and the relative importance of water and steam-power in some countries would probably be reversed. It is because recent developments seem to make such a transport of power possible without excessive cost, and without excessive loss, that a most remarkable interest has been excited in the question of the utilisation of water-power. Take the case of Switzerland, for instance. At the present time Switzerland is said to pay to other countries £800,000 annually for coal. But the total available water-power of Switzerland is estimated at no less than 582,000H.P., of which probably only 80,000 are at present utilised. I found a year ago that nearly every large industrial concern in Switzerland was preparing to make use of water-power, transported a greater or less distance. Besides the great schemes actually carried out at Schaffhausen, Bellegarde, Geneva, and Zurich, where water-power is already utilised on a very large scale, there is a project to develop 10,000H.P. on the Dranse, near Martigny. Hence it is easy to see that problems of distribution of power—that is, the transformation of energy into forms easily transportable and easily utilisable—have now a great interest for engineers. Besides the power required for manufacturing operations, there is a steadily increasing demand for easily-available mechanical energy in large towns. For tramways, for lifts, for handling goods, for small industries, for electric lighting, and sometimes for sanitation power is required. Hitherto steam engines, or more lately gas engines, have been used, placed near the work to be done. But this sporadic generation of power is uneconomical and costly, especially when the work is intermittent; the cost of superintendence is large, and the risk of accident considerable. Hence attention is being directed to systems in which the mechanical energy of fuel or falling water is first generated in large central stations, transformed into some form in which it is conveniently transportable, and capable of being rendered available by simpler motors than steam engines.

Just as in great towns it has become necessary to supersede private means of water supply by a municipal supply; just as it has proved convenient to distribute coal gas for lighting and heating, and to provide a common system of sewerage, so it will probably be found convenient to have in all large towns some means of obtaining mechanical power in any desired quantity at a price proportionate to the quantity used, and in a form in which it can be rendered available either directly or by simple motors requiring but little skilled superintendence.

(*To be continued.*)

Description of the Lifting and Hauling Appliances in Portsmouth Dockyard.

(*Concluded from page* 62.)

Steam Power.—The direct use of steam for the lifting appliances is almost entirely confined to the heavy cranes and sheers, to the portable machines, and to a few cases where there is steam power conveniently near. The large tripod sheers at the east end of the repairing basin, by Messrs. James Taylor and Co., of Birkenhead, have a working capacity of 80 tons, and have been tested to 120 tons; their height is 140ft., and they can overhang the basin wall 40ft., the back leg being worked in and out by means of a screw. Two 50-ton steam cranes by Messrs. Cowans, Sheldon and Co. are also situated at this part of the yard. At the steam basin there are a 40-ton steam crane by Messrs. Fairbairn and Co., and a pair of 40-ton sheers worked by steam, the legs of the latter being worked in and out by guys moved by steam crabs; also a 15-ton steam crane and two hand cranes. On the harbour side there are a pair of 50-ton sheers with fixed legs; and opposite to these, on the side of the ship basin, another pair of 25 tons. In addition to the above there are several smaller steam and hand cranes and capstans spread about the yard; also various travellers in the shops, worked by ropes, by shafting, and by hand.

The travellers in the iron foundry offer a good example of the saving of labour due to the application of power. These 24-ton travellers were originally manual, and required eight men to work them during the pouring of the metal for a moderately large casting. Since power has been applied to them all the operations can now be performed by two men at the most, and with much greater certainty.

Comparative Advantages.—Steam power, as already stated, is almost entirely confined to single machines and central stations. If it could be used without being condensed or cooled in the pipes, it would of course be more economical than either air or water, because it would save all the efficiency lost in the air compressor or in the hydraulic pump. But it is quite out of the question for any extended general service over such a distance as a couple of miles of pipes, and cannot therefore be considered in comparison with the two other systems in regard to general convenience and economy. Comparing, however, the various advantages possessed by the hydraulic and pneumatic systems, the dockyard experience is greatly in favour of the latter. For a number of machines working with a certain amount of regularity, perhaps the hydraulic system would be the better as regards economy; but with work like that in the dockyard, which includes the use of a large number of machines spread about at considerable distances from the source of power, and with extensive variations in the demands made on the power, it is found that the requirements are best and most economically met by the compressed-air system. By means of the air reservoirs sufficient power can be stored up to work about half the machines connected therewith for about two hours; the air-compressing engines can therefore be worked at regular speeds, and stopped if necessary for repairs, without fear of the various cranes and capstans being suddenly brought to a standstill for want of pressure; and it is hardly ever necessary for the pumps to be driven at their utmost speed, even when considerably more than ordinary demands are made upon the pressure. Consequently, the necessity of working the boiler fires harder for only a few minutes' spurt is avoided, together with the waste of fuel due to steam blowing off at intervals. By pumping the reservoirs up in the evening before the yard closes, power is available for opening a caisson or penstock or working a capstan during the night, without having to start the compressing engines at all. Experiments made here show that the relative economical values of the air and hydraulic systems when applied to capstans are as 13 to 11 respectively, while the great balance of convenience is also in favour of the former, in addition to which it is found that the wear is much less in the air machinery than in the hydraulic, and, moreover, that the engines worked by air are less easily disarranged or put out of working order than those worked by water.

Machinery for Working the Sliding Caissons.—The sliding caissons consist of a number of horizontal compartments, of which the lowest but one is fitted with water-ballast tanks and pumps; and the compartment above this is an air chamber, in which are the cranks, etc., for working the pumps that pump out the water ballast. The next compartment above is a strongly bracketed structure for carrying a floor, to which is transmitted all the weight that passes over the upper platform. The chamber or recess into which the caisson floats when opening is covered over and forms part of the roadway; the upper platform of the caisson, with its stanchions and hand-rails, is therefore arranged so as to lower down sufficiently to pass under the road. The engines, which are worked by compressed air, have cylinders of 16in. diameter and 17in. stroke, and are aranged so as to open or close the penstocks of the docks or basins adjacent, to move the shafting for lowering the upper platform of the caisson, and to work the pumps for pumping out the ballast tanks, besides moving the caisson itself by means of chains. For lowering and raising the platform there are in the upper chamber a pair of carriages drawn together or moved apart by a shaft with right and left-handed screws, and these carriages are connected by sixteen pairs of links to the platform above. When the two carriages are furthest apart the platform is up, and all the links are vertical, thus forming a rigid roadway for the heaviest traffic; but when by means of the traversing screws the carriages are brought together, the links become inclined and

the platform is lowered. The stanchions and hand-rails are all jointed, and so connected to the caisson that, as the platform is lowered, they stow horizontally so as to clear. To prevent undue stress on the raising and lowering gear, the moving platform is counterbalanced by weights below. The chains on the lower barrels draw the caisson into the recess, while the upper chains pass over sheaves or fair-leads secured to the masonry, thus forming loops, which, being connected below the fair-lead to projecting arms on the caisson, move it across the dock entrance. While the lower chains are winding on their barrels the upper are unwinding, and *vice versâ*. The caisson while being moved is, of course, kept floating, the water-ballast tank affording a ready means of regulating its displacement according to the height of the tide.

Dock Pumps.—Of main dock pumps there are four sets. The oldest set comprises five chain pumps, working in 24in. barrels and driven by a 40H.P. engine. These, though old-fashioned, still do good service in pumping out the docks in the old part of the yard. They are good for 1600 tons per hour from an average depth of 15ft.; and besides pumping out docks they are used also for pumping up the old basin when it is necessary to have an extra depth of water over the dock sills.

The second set of dock pumps is situated at the back of the factory, and consists of six single-acting lift pumps, with barrels 3ft. diameter, and having a stroke of 2¼ft. The power is obtained by means of gearing from a set of 300I.H.P. compound engines. The aggregate capacity of these pumps is equal to 2500 tons per hour.

The largest and most important dock pumps are the third set, situated in the main pumping station. The engines, by Messrs. James Watt and Co., are of 1000I.H.P., and the pumps have been made and fitted by Messrs. Easton and Anderson. The steam cylinders are 40in. and 64in. diameter by 5ft. stroke; boiler pressure, 80lb. The pumps are single-acting, 8ft. diameter and 6ft. stroke. They were originally double-acting pumps, 6ft. diameter and 6ft. stroke, and were capable of pumping out one of the largest docks in 3¼ hours, which gave a rate of 20,500 tons lifted per hour from a mean depth of 23ft. The wear and tear on the pumps was very great, and they were eventually changed for the present single-acting pumps, and the speed was slowed down, so that it now takes about 4 hours to pump out a dock, giving a rate of about 16,500 tons per hour.

Close at hand is the fourth set, comprising a pair of centrifugal pumps, 6ft. diameter, driven by a compound engine, with 27in. and 50in. cylinders and 3ft. stroke, working 31 revolutions per minute, and developing about 400I.H.P., and driving both pumps at 130 revolutions. These also are by Messrs. James Watt and Co. The pumps together lift at the rate of 7500 tons per hour from the mean depth of 23ft. In designing these centrifugal pumps it was intended that the two should work together until about 20ft. was pumped out of the dock, and then they were to be worked in series, the delivery from one pump becoming the suction for the other. But on the trials it was found that much better work could be done by letting the two pumps both go on drawing direct from the dock; and though the extreme depth from suction to delivery is 40ft., yet the pumps continue to work efficiently to the end.

New Researches on the Calorific Value of Coal.*

THE authors of this paper were desirous of verifying the determinations of the heating value of coal, made by them some years ago with their old Fabre and Silbermann calorimeter. With this view they obtained the loan of Mr. Berthelot's new calorimeter, a detailed drawing of which is given in the original paper. The apparatus is very complete, and consists of a small cylindrical shell about 2⅝in. internal diameter, and 4¼in. deep inside, with a flat cover screwed on. It is made of steel, and lined with platinum to protect the shell from the acids generated by combustion. In the centre is fixed a perforated platinum plate, upon which the coal to be tested is placed. The special feature of the instrument is that, after the coal has been introduced and the cover screwed on, pure oxygen is admitted through an opening, at a pressure of 25 atmospheres. The bomb thus charged is placed in the calorimetric vessel, containing two litres of water, and as soon as the whole apparatus has attained an equal temperature the oxygen charge is fired by an electric spark.

* Inst. C.E.: Foreign Abstracts.

This calorimeter possesses many advantages over the Fabre and Silbermann instrument. Combustion is sudden and complete, there is no unburnt residuum, and no corrections in the calculations are necessary. All the arrangements and multiplied observations required in the old system are dispensed with, and the apparatus is so simple that one operator only is needed to work it. On the other hand, it is rather costly, and the ashes cannot be weighed, because the charge ignites with such force that they are driven against the sides of the shell, and it is impossible to collect them afterwards intact. In making experiments, therefore, the authors were careful to determine the percentage of ash beforehand in a preliminary trial. The coal to be tested for ash was ground to powder, thoroughly mixed, and made into pellets each 1grm. in weight. The proportion of ash was determined from the mean of five of these pellets burnt in the calorimeter. Another difficulty was found in estimating the calorific value of the coal. Small quantities of nitric and sulphuric acid were formed during combustion, and the heat required for these processes had to be determined and deducted from the total heat developed.

The authors are, nevertheless, of opinion that with this apparatus of Mr. Berthelot greater accuracy is possible than with the Fabre and Silbermann calorimeter, because it is more easily handled, and the figures require fewer corrections. As their first experiments with the Berthelot calorimeter gave slightly lower results than those of former trials, they determined to check the new figures with a calorimeter of the old type, modified in a few important particulars. Instead of using one general coefficient of correction for the temperature of the surrounding atmosphere, the coefficient was determined separately for each trial. It was found that the Fabre and Silbermann instrument had given rather higher results than those now obtained, and that the coefficient for temperature ought to be halved.

Another important alteration was made in the method of preparing the fuel for combustion. In order to obtain perfect uniformity in the samples, it had been previously considered necessary to reduce a quantity of the coal to powder, and mix it thoroughly before burning. The authors are now of opinion that the coal, if taken from the same pit and seam, is sufficiently regular in its structure to require no mixing, due allowance being made for the ash. In a Fabre and Silbermann calorimeter they placed a sample from the block, broken into pieces the size of a pea, and this change produced another important modification in the results. With powdered coal the oxygen used for combustion had to be mixed with air to prevent an explosion, combustion was incomplete, and unburnt gases were given off in large quantities. With lump coal pure oxygen might be used, better combustion was obtained, and the corrections for unburnt residuum were half what they had formerly been. These improvements in the old system brought the results much nearer those arrived at with Mr. Berthelot's new calorimeter.

With both calorimeters the authors found that the calorific value of the coal was less than had been formerly calculated, although the relative heating value of the different kinds of coal was not altered. As regards their calorific value for steam boilers, the old results were not materially affected, but the theoretic classification of coals according to the greater number of thermal units found with the calorimeter than by calculation was modified. Fewer coals showed this excess of actual over theoretic value, and more gave figures denoting a lower heating value with the calorimeter than by calculation from the elements.

Applying these new working methods the authors proceeded to revise their determinations of the calorific value of different coals tested with the old instrument. Thus, in experiments made in 1888 with Fabre and Silbermann's calorimeter, on a sample of Nixon's navigation coal supplied by Mr. B. Donkin, jun., the calorific value, pure and dry, was found to be 15,955 thermal units. When burned in the Berthelot calorimeter it gave 15,660 thermal units. A sample of 1grm. Ronchamp coal tested in the Berthelot calorimeter contained 88·08 per cent. of carbon, and its heating value pure and dry was 15,516 thermal units. Experiments made on the same coal in 1868 under the old system gave the calorific value as 16,103 thermal units, or nearly 4 per cent. more.

Three samples of Welsh coal tested in the Berthelot calorimeter gave 15,654, 14,875, and 15,660 thermal units as their calorific values. These figures were higher than the thermal units found by calculation according to Dulong's formula, and with one exception lower than those calculated from the heating value of the carbon and hydrogen present. In the tested sample of Nixon's navigation coal, the heating value, as determined by the calorimeter was 115 thermal units less than that of the carbon and hydrogen combined, and 360 thermal units above that calculated from Dulong's formula. Two samples of coal from the North of France gave the following curious results:—In the first the calorific value determined in the Berthelot calorimeter was 14,954 thermal units, or 0·6 per cent. more heat than the total heat calculated from the hydrogen and carbon it contained, and 4·9 per cent. more than the calorific value of the coal calculated from Dulong's formula. The other sample was found to contain 15,955 thermal units, or 6·4 per cent. less than the calorific value of the carbon and hydrogen combined, and 6·1 per cent. less than that calculated by Dulong's rule.

The authors arrive at the conclusion that it is impossible to ascertain correctly the calorific value of any given coal by calculation, and that it should be tested in a good calorimeter. With some coals the calorific value in the calorimeter is greater than that of the combined carbon and hydrogen; with others it is less, but exceeds the calorific value calculated according to Dulong's law; while with a third kind of coal, the heat values given in the calorimeter are lower than those obtained by calculation from Dulong's rule.

Metal Trade Memoranda.

A new syndicate has been formed with a view to the purchase of the undertaking of the Maryport Hematite Company.

Corundum mining has been resumed on an extensive scale in the Transylvania section of North Carolina. The Hog's Back Mine has shipped 70,000lb. during the month of July.

The shipments of iron and steel continue to show a marked decline. In July 221,894 tons were exported, as against 290,803 tons and 394,724 tons in July of 1891 and 1890 respectively.

It is expected that the tinplate works of Messrs. P. H. Laufman and Co., Butler Junction, Pennsylvania, will shortly commence operations. The works are capable of producing 200 boxes per week.

There appears to be some prospect of an early inauguration of the iron industry in the Argentine Republic by the opening of the Romay Iron Mines, a short distance from Frias, on the National Central Northern Railroad.

Spanish ore in large quantities has been bought by the Barrow Steel Company and other companies, and delivered at their works at a less price than Furness raisers can afford to sell at, and this notwithstanding the fact that there are large banks of iron ore at the mines.

The effect of the prolonged stoppage of finished-iron works in Pennsylvania upon the demand for pig iron, consequent upon the labour troubles, has been so marked as to lead to the blowing out of a large number of smelting furnaces. The rate of production of pig iron is now about 12 per cent. less than it was at the beginning of March.

Mr. J. W. Richards describes in the "Journal of the Chemical Society" his experiments for the redetermination of the specific heat of aluminum at temperatures between 16° and 22°, by noting the reduction in temperature produced by 100grms. or 200grms. of aluminum in a known weight of water at a higher temperature; at temperatures between 22° and 100°, by dropping aluminum, from suspension in steam, into water in a calorimeter; and at temperatures from 120° to 600° by heating a ball of platinum and a ball of aluminium placed together on a platinum support in the same air bath or furnace, and dropping them simultaneously into two exactly similar calorimeters. The true specific heat at 0° was found to be 0·2220, making the specific heat at 20° 0·2240; at 100° 0·2320; at 625°—melting point—0·2845, giving total caloric capacity to the melting 158·3. This gives 6·13 as the atomic heat, using the mean specific heat between 0° and 100°.

The Metal Market.

PRICES CURRENT.

LONDON, Aug. 15.

COPPER opened a shade easier, and showed no subsequent quotable variation, but a better tone was imparted to the market by the reaction in silver, and the close is firm at a decline of 1s. 3d. on the day. Late October prompts made £44 6s 3d.; sharp cash, £44 7s. 6d.; and late August, £44 8s. 9d Sales, 200 tons. Settlement price, £44 7s. 6d. English tough, £47 10s.; best selected, £48 10s.; strong sheets, £56.

TIN has been in poor demand, but prices have been sensitive to any inquiry for cash, and the close is firm at a general advance of 5s. A carrying business over three months was done at evens in the afternoon. Ordinary transactions were confined to cash at £94 5s. Settlement price, £94 5s. English ingots, £97.

PIG IRON has been firmly held, and although 41s. 11d. was bid for Scotch, cash, after the official close, no business was effected. Middlesbrough was also held above buyers' views, and closed 3d. better; but hematite was unchanged. Settlement prices:—Scotch, 41s. 10d.; Middlesbrough, 39s. 4d.; hematite, 49s. 3d.

TINPLATES are steady. I.C. coke, f.o.b. London, 13s.; Liverpool, 12s. 6d.; Swansea, 12s. 3d.

LEAD remains flat at £10 5s. sellers, Spanish; English, £10 10s.

SPELTER is without feature, and August shipment is available at £21 6s. 3d. Silesian specials, ex. ship, £22.

ZINC.—In Silesian sheets holders have reduced prices 2s. 6d. without stimulating business. Ordinary, £23 12s. 6d., ex. ship, London. Belgium is quiet. V.M. brands, £24 ex. ship, and £23 15s. f.o.b. Antwerp.

OFFICIAL CLOSING QUOTATIONS.

	£ s. d.	£ s. d.
COPPER—		
G. M. B.—Cash	44 7 6	44 15 0
„ Three months	44 18 9	45 6 3
English tough	— — —	
Best selected	— — —	
Strong sheets	— — —	
TIN—		
Fine foreign, cash	94 5 0	94 15 0
„ three months	94 5 0	94 15 0
Australian, cash	£4 15 0	95 5 0
PIG IRON—	s. d.	
Scotch warrants Cash	41 10½	
„ One month	42 1	
Middlesbrough—Cash	39 4½	
„ One month	—	
Hematite—Cash	49 3	
„ One month	—	

GLASGOW, August 15.—Pig iron opened fairly active in the morning. 12,000 to 14,000 tons Scotch changing hands. In the afternoon, however, less was doing, and the day's total did not reach more than 18,000 tons. Some of the selling was said to come from London. Prices were very steady. One lot of Scotch was sold at 41s. 11½d. 14 days fixed, with 1s. forfeit in sellers' option. Since Friday, Scotch has dropped ½d. cash, while Cleveland, though undealt in, was quotably 3d. dearer. Hematite was unaltered. The shipments last week were 6365, an increase, compared with same week last year, of 1609 tons.

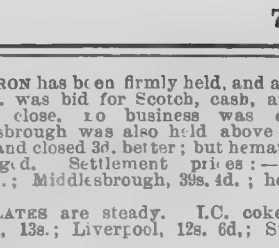
QUOTATIONS.

	Highest. s. d.	Lowest. s. d.
Scotch warrants—Cash	41 11½	41 10
„ One month	42 1	42 0½
Middlesbrough—Cash	39 4½	39 1½
„ One month	—	—
Hematite—Cash	49 3	49 3
„ One month	—	—

Trade Marks.

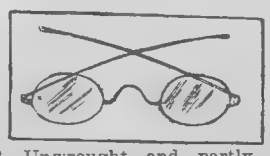
The following is the Official List of Applications published from July 27 to August 10, for the Registration of Trade Marks, so far as relates to the Metal Trades.

CLASS 5.



165,017. Unwrought and partly wrought metals used in manufacture—namely, rough, pig, ingot, hoop, wire, bar, rail, bolt, sheet, or plate iron, steel, lead, copper, zinc, tin, bismuth, or antimony. WILSON, LATHAM AND CO., 34, King-street West, Manchester; merchants.—26th May, 1892.

CLASS 5.



165,018. Unwrought and partly wrought metals used in manufacture—namely, rough, pig, ingot, hoop, wire, bar, rail, bolt, sheet, or plate iron, steel, lead, copper, zinc, tin, bismuth, antimony. WILSON, LATHAM AND CO., 34, King-street West, Manchester; merchants.—26th May, 1892.

CLASS 5.

164,175. Rolled iron, copper, tombac, and brass; brass and copper wire; iron, copper and brass blanks, discs, and cups for cartridge cases, buttons, medals, percussion caps, and lamps; bronze blanks for coins and other metal articles of a like manufacture included under Class 5. THE BIRMINGHAM SMALL ARMS AND METAL COMPANY LIMITED, Small Heath, Birmingham; makers of small arms and cartridges, metal rollers, refiners and workers.—13th April 1892. Mark used at least twelve months prior to the 13th August, 1875.

CLASS 5.

LOTUS.

164,532. Unwrought and partly wrought metals used in manufacture. JEREMIAH LYON AND COMPANY, 4, Lombard-court, London, E.C.; merchants.—3rd May, 1892.

CLASS 5.

CHRYSANTHEMUM
JOHN BIRCH & CO. LONDON.

165,769. Iron and steel, pig or cast; iron, rough; iron, bar and rail, including rails for railways; bolt and rod iron; sheet iron; boiler and armour plates; hoop iron; lead, pig, rolled, sheet; wire, copper, zinc; gold in ingots. JOHN BIRCH AND COMPANY, 10 and 11, Queen Street-place, London, E.C.; merchants and engineers.—4th July, 1892.

CLASS 13.

BANKS & STEAD
ALBERT

"The essential particular of the Trade Mark is the device, and the applicants disclaim any right to the exclusive use of the name 'Albert.'"

164,703. Bolts, nuts, and screws. KIRBY BANKS, trading as BANKS AND STEAD, Albert Screw Works, Meadow-lane, Leeds, Yorkshire; manufacturer of bolts, nuts, and screws for machinery and sewing machines.—10th May, 1892.

CLASS 50.

"MEAD'S" VICEROY
GUN METAL PACKING
SOLE MAKERS LONDON

"The essential particulars of the Trade Mark are the signature and the word 'Viceroy,' and applicant disclaims any right to the exclusive use of 'Mead's Gun Metal Packing,' and 'Sole Makers, London.'"

164,814. Steam packing. EDITH MEAD, trading as FREDK. M. MEAD AND CO., and as F. M. MEAD AND CO., 7, Calverdale-road, Clapham, London, S.W.; manufacturer of steam and hydraulic packing.—14th May, 1892.

Official Gazette.

Partnerships Dissolved.

R. DIBSDALL and W. N. THRING the younger, under the style of R. Dibsdall and Co., Yeovil, engineers, iron and brass founders, and general smiths.

J. and R. STEELE, under the style of E. Steele, Manchester, chainmakers.

AINLEY and BURLEY, Elland, Yorkshire, wire manufacturers.

THE BANKRUPTCY ACTS, 1883 AND 1890.

Receiving Orders.

JEREMIAH CANNIFFE, Great Saffron-hill, Holborn, W.C., and Walthamstow, engineer.

J. COLLINS, Hove, Sussex, electrical engineer.

J. READ (lately trading as J. Reed and Co.), Cardiff, engineer.

S. S. WELCH, Plymouth, engineer.

Adjudication.

J. READ, Cardiff, engineer.

Winding-up Notice.

THE KENSINGTON COURT ELECTRIC LIGHTING COMPANY LIMITED, London.

Commercial Gazette.

☞ The name given is that of the defendant; the amount is that for which judgment was given, and the date is that on which it was given.

County Court Judgment.

D. MELLOR and Co., Ilkeston, ironfounders, £13 6s. 13th July.

New Companies.

RENTON GIBBS AND CO. LIMITED.—This company was registered on the 10th inst., with a capital of £10,000, in £5 shares, to acquire, take over as a going concern, and carry on the business of a heating and ventilating engineer, steam oven builder, mechanical and electrical engineer, etc., carried on by Mr. R. Renton Gibbs, at Liverpool and elsewhere. Registered by Messrs. Kerr and Lanham, 3, Chichester Rents, Chancery-lane, W.C.

VICTORIA REGENERATIVE SMOKE CONSUMER LIMITED.—This company was registered on the 5th inst., with a capital of £20,000, in £10 shares, to enter into and carry into effect an agreement (the particulars of which are not mentioned) for the acquisition of certain letters patent granted to H. Walker, for "Improvements in and connected with steam boiler and other heating, melting, and smelting furnaces, muffles and the like for various purposes," and for "Improvements in or additions to steam boiler and other furnaces," and to develop and turn to account the said inventions. Registered by Waterlow Bros. and Layton Limited, 24, Birchin-lane, E.C.

SPERRYN, MCDONALD AND CO. LIMITED.—This company was registered on the 9th inst., with a capital of £5000, in £10 shares, to acquire and carry on the business of manufacturing and selling brass and iron fittings for the electric light, gas, steam, etc., carried on by Mr. J. N. Sperryn, at 181, Queen Victoria-street, E.C., and 344, Newtown-row, Birmingham. Registered without articles of association, by Mr. R. W. McDonald, 181, Queen Victoria-street, E.C.

COLVER BROTHERS LIMITED.—This company was registered on the 6th inst., with a capital of £20,000, in £50 shares, to acquire, take over as a going concern, and carry on the business of steel manufacturers and merchants, carried on at the Pilot Works, Sheffield, under the style or firm of "Colver Brothers," and with a view thereto to enter into the agreement with Messrs. J. Jonas and R. Colver referred to in clause 2 of the articles. Registered by Mr. G. J. Simpson, solicitor, Sheffield.

HOVE ELECTRIC LIGHTING COMPANY LIMITED.—This company was registered on the 4th inst., with a capital of £40,000, in £5 shares, to enter into and carry into effect the agreements with the Hove Commissioners and Messrs. Crompton and Co. Limited, referred to in clause 3 of the articles, and to carry on in the district of the Hove Commissioners the business of an electric light company in all its branches, and to carry on the business of electricians, electrical and mechanical engineers, suppliers of electricity, and manufacturers of electrical and scientific apparatus. Registered by Messrs. Deacon, Gibson, and Medcalf, 4, St. Mary Axe, E.C. Registered office, Mansion House Buildings, E.C.

JONAS AND COLVER LIMITED.—This company was registered on the 6th inst., with a capital of £125,000, in £50 shares, to acquire and take over as a going concern the business of steel manufacturers and merchants carried on by J. Jonas and R. Colver, at the Continental Steel Works, Attercliffe, Sheffield, under the style of "Jonas and Colver"; to enter into and carry into effect an agreement mentioned in clause 3 of the articles (with the said J. Jonas and R. Colver), and to carry on the business of steel manufacturers and merchants, ironfounders, smelters, ironmasters, metal workers, coal masters, quarry owners, brick and tile makers, wire drawers, machine makers, etc. Registered by Mr. G. J. Simpson, solicitor, Sheffield.

Miscellaneous Items.

A valuable seam of coal, nearly 7ft. thick, has been discovered at Ashton-under-Lyne Moss Colliery. It is believed to cover 1000 acres.

The Mexican Government has concluded a contract with the Boleo Copper Mining Company, of Lower California, for the improvement of the harbour of Santa Rosalia, on the Gulf of Cortes.

The streets of Brixton Hill, London, are being paved with West Australian jarrah. The life of the ordinary wooden pavement in England is two and a half years, but the life of jarrah as a wooden pavement has not been decided, though it is believed to be the finest wood for the purpose which exists.

A large compound steam engine has been constructed by Messrs. W. B. Thompson and Co. Ltd,, Dundee, for the Serdjgunge Jute Factory Company, near Calcutta. It has cylinders 30in. and 56in. diameter, with a stroke of 72in., and is designed to indicate 1400H.P. when running at 60 revolutions per minute, with a steam pressure of 120lb. per square inch. The fly-wheel is 25ft. in diameter, is grooved for 26 ropes, and weighs 40 tons. Magnolia metal is fitted into the crank-shaft bearings, and also in the cross-head slide blocks. At the steam trial everything worked smoothly and without the slightest heating.

The model Newcomen engine has been placed in the Museum at South Kensington, and kept in action, the necessary heat being supplied by a gas burner. The interest shown in this model owing to its being in motion suggested the desirability of placing other models in motion, and now ten models have been set in motion—Newcomen's engine of 1720; Watt's sun and planet engine; two beam engines by Watt, with modified parallel motions and air-pumps; Watt's cabinet engine; sectional model of the cabinet engine; later beam engine by Miller; grasshopper beam engine; horizontal engine by Hornsby, with automatic expansion gear; modern steam fire engine. In all cases the moving machinery is under glass.

In the opinion of Dr. Michaelis, of Berlin, the greatest enemies to the permanency of the Portland cement used in marine structures are the sulphates contained in sea water. If there is any great quantity of alumina and ferric oxide in the cement the structure breaks up sooner than otherwise. This is accounted for by the fact that the sulphate forms with the aluminate and ferrate of lime a number of crystalline compounds, such as basic sulphate of lime, alumino-sulphate and ferro-sulphate of lime. These compounds take up a large quantity of water of crystallisation, so that the total volume is much increased. Hence the weakness and disintegration of the cement structure. Dr. Michaelis considers that the separation of hydrate of magnesia is quite innocuous, for it is only displaced from its solution in the form of a flocculent slimy hydrate which, if anything, is useful in stopping up the pores. His general recommendation to users of concrete for marine work is to choose a cement rich in silica, and as poor as possible in alumina and ferric oxide, and to envelop the structure with an impermeable mixture composed of one part of cement with 2 to 2½ parts of sand of mixed grain, of which at least one-third should be very fine sand, and to this the requisite amount of ballast should be added.

The engineers who are engaged in the survey of the proposed new line of railway from Longride, near Preston, to Ingleton, report the discovery of a large deposit of coal and of China clay. There is every reason, it is said, to believe that the proposed railway would not only be a very remunerative undertaking, but that it would tend to develope a large industry.

A party of about twenty junior engineers, who are members of the London Junior Engineering Society, are on a holiday tour to various centres of industry. On Saturday, the 13th inst., they visited Crewe and Chester. On Monday, the 15th inst., they arrived in Salford, their first visit being to the ironworks of Messrs. Hulse and Co., Ordsall-lane. They also inspected the sewage works of the Salford Corporation at Mode Wheel, and were subsequently entertained to luncheon at the Salford Town Hall by Mr. Joseph Corbett, the borough engineer. After lunch the party were conducted over the extensive works of Messrs. Mather and Platt, by Mr. T. Thorpe, the managing director of the Salford Ironworks.

The publisher of "The Mechanical World" will send a prepaid parcel of specimen copies to anyone, in any part of the world, who can distribute them advantageously amongst his engineering friends. Business card or bill-head should be enclosed as a guarantee of good faith, and number of copies stated.—Address: 391, Strand, London, or New Bridge-street, Strangeways, Manchester

Prize Competition.

WE OFFER FOUR GUINEAS MONTHLY IN PRIZES FOR THE BEST ORIGINAL ARTICLES SENT IN ON ANY MECHANICAL, ENGINEERING OR ELECTRICAL SUBJECT.

IN ORDER THAT MANAGERS, DRAUGHTSMEN, FOREMEN, AND WORKMEN WHO HAVE HAD NO PRACTICE IN WRITING MAY NOT HESITATE TO SEND IN COMPETITIONS, IT IS TO BE UNDERSTOOD THAT ALL ARTICLES WILL BE FULLY EDITED AND CORRECTED, AND JUDGED OF SOLELY ON THEIR MERITS AS ORIGINAL CONTRIBUTIONS FROM A PRACTICAL POINT OF VIEW. THE OBJECT OF THE COMPETITION IS TO INDUCE PRACTICAL MEN TO COME FORWARD AND GIVE THE RESULTS OF THEIR EXPERIENCE.

CONDITIONS.

Competitions for our Monthly Prizes must be sent so as to arrive at the Manchester Offices of THE MECHANICAL WORLD, New Bridge-street, not later than the last Tuesday in each month. Articles arriving after that time will be placed in the following month's competition.

Written competitions must be on one side of the paper only. The contributions must be original, and relate to matters connected with Engineering, Mechanism or Electricity.

The Proprietors of THE MECHANICAL WORLD reserve the right to publish any competition, whether it gains a prize or not.

The competitions may be accompanied by diagrams, sketches or drawings.

Competitors should write the words "Prize Competition" on the envelopes.

Competitors are not confined to one, but may send any number of competitions.

The correct name and address of the sender *must* be distinctly written upon every competition, not necessarily for publication. Competitions can appear under a *nom de plume*.

☞ We cannot undertake to be responsible for any MSS. sent to us, though when stamps are enclosed for the purpose we will endeavour to return rejected contributions.

Queries.

☞ Readers are invited to avail themselves of this section for practical information on questions relating to Mechanical Engineering and the Scientific Industries.

☞ Queries and Replies should arrive at the Manchester Office not later than by the first post on the Tuesday preceding the date of publication.

MAKERS OF CELLULOID.—Required the names and addresses of extensive makers of celluloid.—B. P.

MAKERS OF STAMPED FORGINGS.—Required the names and addresses of firms making drop stamped joints and pins in small quantities.—J. T.

NICKEL.—In an alloy of cast iron and nickel what is the increase in strength over cast iron, and what proportion of nickel should be used?—T. C.

ECONOMISER SCRAPERS.—What means must I adopt to renew some broken scrapers in the middle of the range of pipes in the economisers?—PUZZLED.

PATTERNMAKER'S TOOL BOX.—Will any reader give me a sketch of the patternmaker's tool box, with full dimensions and particulars?—APPRENTICE.

MAKERS OF COMPRESSED PAPER.—Will any reader inform me of the address of a maker of compressed paper, such as is used for carriage wheels and the like?—T. D.

RIFLING MACHINE.—I should be glad of a sketch of any appliance used for rifling out small barrels, such as revolvers, etc., say ¼in. to ⅝in. bore, with threads, say, 6in. pitch.—NEMO.

WOVEN BELTING.—Can anyone give me the recipe for or supply me with the proper paint for cotton belting? I can weave it right enough, but cannot get a satisfactory paint.—BARCELONA.

HARDENING CIRCULAR SAWS.—Can anyone tell me how to harden a circular saw 20in. diameter and ⅛in. thick, to saw cast iron? I want to harden the cutting part only, and not the body of the saw.—J. WILSON.

JAMES PATENT SOUNDING MACHINE OR SUBMARINE SENTRY.—Can any reader oblige with particulars of this apparatus, or name of makers?

HOT-AIR ENGINE.—Will some reader of THE MECHANICAL WORLD kindly oblige me with a section and principal dimensions of a ½H.P. single-acting hot-air engine of the Stirling cycle?—GEO. H. PERKINS, North Queensland.

ROLLER-BORING TACKLE.—Will some reader favour me with a sketch of a tool for boring hard wood rollers of various kinds in the lathe from 1ft. to 3ft. in diameter, and from 3ft. to 5ft. long? The holes are to pass right through, and to be from 1in. to 3in. diameter.—BORE.

VOSPER'S ENGINE.—I have a Vosper's patent high-speed four-cylinder engine, and should be glad to know what the cut-off in each cylinder should be; also the position of eccentric sheave at any given point? I believe the eccentric sheave has been altered before the engine came into my hands. A sketch would oblige.—R. F.

LOSSES IN STEEL FURNACES.—Could any reader kindly inform me the average per cent. of actual loss, and the average per cent. of skull, in the charge of a Siemens open-hearth steel furnace working charges of from 30 to 40 tons? And also the per cent. of loss in heating slabs and ingots in the Siemens regenerative gas furnace?—J. R. R.

BOAT PROPULSION.—If a boat floats down a river, will it be carried forward at the same speed as the stream is flowing? Or can it be proved that it will go slower than the stream? How much force in lb. will be required to propel a boat of a given weight against a stream or up a river flowing with a certain velocity, so that the boat shall move up the river with the same speed that the stream is flowing down?—HYDRA.

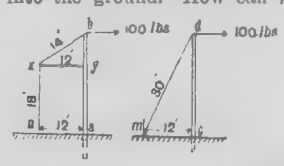
WATER FLOWING INTO JET CONDENSER.—Will some fellow-reader kindly give me a worked-out example of the quantity of water that will flow through a 4in. pipe 30ft. long, with four bends, into a jet condenser with 18in., 24in,, and 28in. of vacuum; wheel valve wide open, giving same area as pipe; also with it half open? The water supply tank is 8ft. below condenser. The condenser is working on a set of triple-expansion engines. What effect have bends and temperature on supply water?—SUGAR MILL, North Queensland.

LOCOMOTIVE CONSTRUCTION.—Will any correspondent enlighten me as to the mode adopted in locomotive work in order to fix the position of the axles (horizontally) so that each axle may have a predetermined portion of the total weight resting upon it? Say:—

Load on leading axle	.....	0·32
,, driving ,,	.....	0·48
,, trailing ,,	.....	0·20
		1·00

Of course, I am aware there are certain circumstances—such as length of barrel, position of firebox, etc.—which in practice to a great extent influence this; but the point I wish clearing up is: Given the total weight, how are the positions of axles determined so that the pre-arranged weights rest on them? An answer would be of service to others as well as to—HILLSLAND.

STAYING TELEGRAPH POSTS.—*a b* and *c d* are two telegraph posts of equal height, firmly fixed into the ground. How can *m d* be



proved to be a stronger way of staying than *n x b*? Also, what is the compressing thrust on the strut *x y*, and the bending moment about *y*?—TELEGRAPH POST.

Replies.

☞ Owing to the constant increase in our correspondence we regret that we have no alternative but to announce that we cannot reply by post to Queries even when stamped envelopes are sent.

☞ Queries and Replies must in all cases be accompanied by the names and addresses of the writers, as no notice will be taken of anonymous communications.

BOILER.—90lb.

A. H.—Try melted resin.

J. B. ENTWISTLE.—No address is given in your letter.

W. JOHNSON.—We are obliged for your letter. It should be "three," not "eight."

TOOLS.—We are not aware that any fixed standard is adopted in this country.

APPRENTICE.—You are not quite precise in your query. If you will state the particular scholarships you mean we will try and assist you.

NOVICE.—1. No, it does not help in any other way in addition to that you mention. 2. Goodeve's book is rather advanced. 3. The book you name gives the meaning of the terms used in all classes of engineering.

W. BURRELL.—You will not obtain any increase of power unless you are able to increase your boiler pressure. You would obtain a slightly better economy of working; but to get the best results you must use a higher steam pressure. You can obtain the specifications by sending a Patents postcard to the Patent Office. These may be had at any General Post-office.

ALPHA.—By covering the pipes first with a layer of about 1in. in thickness of ordinary insulating material, such as straw and clay, etc., and coating this with a thin layer of a mixture of infusorial earth with soda water glass, good results will be obtained. In applying the mixture, care must be taken to lay on a fresh quantity only when the first layer is entirely dry, which may be readily recognised by the white appearance of the coat. To make the layer more durable, a light coat of oil should finally be given. Felt, cork waste, mineral wool, or asbestos pulp, either made into suitable forms and attached to the pipe or filled into a casing surrounding the pipe, and with or without an air-space about the pipe, are much used for the above purpose also.

J. KNOWLES.—(1) There is very little fault to be found with the cards sent. The diagram from the front end of the L.P. cylinder shows a want of lead to exhaust, and should be altered so as to make the toe of the diagram resemble that from the back end of the same cylinder. (2) A ½th spring would suit you. (3) About 10s. we think.

Latest Inventions.

APPLICATIONS FOR LETTERS PATENT.

When Patents have been "communicated," the name of the communicating party is printed in italics.

Where complete specification accompanies application, an asterisk is suffixed.

2nd August, 1892.

13,928 TAPS for WATER and OTHER LIQUIDS. J J Hancock.
13,931 FORCE PUMPS. J Baker.
13,932 TELEPHONE SWITCH BOARDS. J W and H T Yates.
13,933 STEEL. T Hampton.
13,939 OBTAINING MOTION.* R C Sayer.
13,940 AIR-PUMPS. W Reininghaus.
13,942 APPARATUS for the VENTILATION of STEAM VESSELS. T M Rymer-Jones.
13,943 STARTING GEAR for PETROLEUM ENGINES. F W Linchester.
13,944 THE "CLARENCE" DRIVING GEAR for SEMI-ROTARY PUMPS. J L Copland.
13,945 TENSION or LOCK-NUT. H Roe and the Roulette Cycle Co. Ltd.
13,949 INTERLOCKING SIGNAL and POINT LEVER. C M. Anderson.
13,950 STEAM ENGINES. V Coates and Co. Ltd. and W D Ferguson.
13,952 RIVETING MACHINES. V Coates and Co. Ltd. and V H Coates.
13,954 PISTON PACKING RINGS. T Shepherd and M Oliver.
13,955 IGNITING APPARATUS for GAS or PETROLEUM ENGINES. T Bolas and W C Horne.
13,960 MEANS for SKIMMING MOLTEN METAL in APPARATUS for TINNING IRON or STEEL PLATES. D and B Jones.
13,962 MACHINERY for SAWING and SPLITTING WOOD. A W Glover.
13,964 VALVES and JOINTS.* C S Bavier.
13,968 GRINDING or CRUSHING MILLS. T W Brittain.
13,972 PULLEYS, RIGGERS, and FLY-WHEELS. C Walker.
13,979 DISTANCE MEASURING INSTRUMENTS. W P Thompson. (*A Ungerer, jun.*, Bavaria.)
13,987 CLUTCHES or COUPLINGS.* L Kleritj.
13,989 TELEPHONE.* J W Gibboney and E Thomson.
13,990 CENTRIFUGAL ORE SEPARATORS.* O B Peck.
13,991 PROCESS of SEPARATING POWDERED PARTICLES containing MINERAL BEARING SUBSTANCES of DIFFERENT DEGREES of SPECIFIC GRAVITY.* O B Peck.
13,992 WHEELS and PULLEYS.* H Claus.
13,999 MODE of MANUFACTURING KEY BLANKS. N G Sörensen.

3rd August, 1892.

14,005 FEED-WATER PURIFIERS and HEATERS. J Williamson.
14,009 APPARATUS for CLEANING the TUBES or FLUES of TUBULAR BOILERS. G Woodhead and J Pickup.
14,010 APPARATUS for CUTTING PAPER in ROLLS. J B Young and J S Rigby.
14,013 UTILISING STEAM for MOTIVE POWER and HEATING. J Murrie.
14,023 NAIL-CUTTING MACHINERY. J Grimshaw.
14,031 CONTINUOUS WORKING TURBINE for the TREATMENT of VARIOUS MATERIALS. E M Lévy-Samson.
14,034 CONSTRUCTION of STEAM BOILERS, and FURNACES THEREFOR.* H Schomburg.
14,035 ELECTRIC INCANDESCENT LAMPS.* J Pinter.
14,039 APPARATUS for PURIFICATION of SEWAGE and OTHER PURPOSES. W Walker.
14,043 ARC LAMPS. W J H Jones.
14,044 ELECTRODES for SECONDARY BATTERIES.* J C Fell. (*W Morrison*, United States.)
14,047 APPARATUS for REGULATING the FLOW of VOLATILE LIQUID in REFRIGERATING MACHINES. T B Lightfoot. (*Gesellschaft für Lindes Eismaschinen*, Germany.)
14,048 PANTOGRAPHS. L Kleritj.
14,050 WRENCHES. D C Weist and others.
14,056 ELECTRIC MOTORS.* H H Lake. (*W Stanley, jun.*, and *J F Kelly*, United States.)
14,059 METALLIC PACKING RINGS. C Watson.
14,060 DYNAMO-ELECTRIC and ELECTRO-DYNAMIC MACHINES. A I Grevier.

4th August, 1892.

14,074 CONTINUOUS DIRECT ELECTRIC CURRENT MACHINE and MOTOR. W Aidred.
14,074 BELT FASTENERS.* F Reddaway. (*W M Whiting*, United States.)
14,079 GAS MOTOR ENGINES. W Rowbotham and J Bradley.
14,086 LOCKING NUTS on SCREWS or BOLTS. J Barlow.
14,089 DRY BATTERIES.* C C Lesenberg and J von der Poppenberg.
14,090 SHAFT GOVERNORS. H Lindley.
14,094 HEATING of FEED WATER or SUPPLY WATER for STEAM BOILERS.* A Miller.
14,095 AUTOMATIC ELECTRIC ARC LAMPS G H Church.
14,102 ELECTRICALLY APPLYING RAILWAY BRAKES.* W P Thompson. (*O Berndt*, Germany.)
14,103 HEATING APPARATUS for HEATING and DRYING CHAMBERS. Z A Berry.
14,107 LIQUID and GASEOUS METERS. H Paasch.
14,109 MOTORS. F Mitchell.
14,110 STEAM BOILERS. G Cawley.
14,112 PROPELLING MECHANISM for BOATS. W E Crisp.
14,115 APPARATUS for PRODUCING CIRCULATION of WATER in STEAM BOILERS. H S Maxim.
14,123 SECURING RAILS to IRON SLEEPERS.* C Banovits.
14,124 APPARATUS for EXCAVATING and REMOVING COAL. F Hurd.

5th August, 1892.

14,132 DETACHABLE HANDLES for SAWS. W A Bramley.
14,134 STAND for SUPPORTING COMPRESSED FLUID CYLINDERS. W J Crighton.
14,136 VALVES.* A Turnbull.
14,137 EXPANSION JOINTS for PIPES.* A Turnbull.
14,141 GAS MOTOR ENGINES. W Rowbotham and J Bradley.
14,142 AUTOMATIC CLAMPING ARRANGEMENT for GUILLOTINE CUTTING MACHINES. S A Goddier.
14,145 MECHANICAL STOKERS. J Proctor.
14,147 EXTRACTING GOLD from its ORES. F W Durham.
14,148 PROPELLING BOATS and BARGES C N Garner.
14,149 DEVICE for the BETTER VAPOURISING of OILS. T F Carter.
14,150 OIL and GAS MOTOR ENGINES. J Southall.
14,153 FRICTION and LIKE GEARING. F W Lanchester.
14,154 AUTOMATIC DUMPING APPARATUS. J R Wilson.
14,162 LAGGING of FURNACES and BOILERS. J Kirchmann and K Schwinghammer.
14,170 FRICTION COUPLINGS. O and R F Beck.
14,175 MANUFACTURE of MATERIALS USED in the PURIFICATION and FILTRATION of SEWAGE. C E Bell.
14,177 OVERHEAD ROPE RAILWAYS with SUPPORTING and TRACTION ROPES.* B I Rydberg.
14,180 ELECTRIC BATTERIES. J L Dobell.
14,181 ELECTRIC BATTERIES. C P Shrewsbury and J L Dobell.
14,189 APPARATUS for DISTRIBUTING ALTERNATING ELECTRIC CURRENTS.* H H Lake. (*W Stanley, jun, and J F Kelly*, United States.)
14,193 ELECTRICALLY CONTROLLED VALVES. A Franke.
14,194 GUILLOTINE MACHINES for CUTTING PAPER and CLOTH. H J Salmon and others.

6th August, 1892.

14,198 APPLIANCE for USE in ACTUATING FRICTION CLUTCHES and PULLEYS. W G Cowlishaw and C E Walker.
14,199 ELECTRIC TESTING INSTRUMENT. A A Day.
14,204 FEED WATER HEATING and PURIFYING APPARATUS for STEAM BOILERS. J Shepherd.
14,206 ELECTRIC BATTERIES. J L Dobell.
14,217 AUTOMATIC ELECTRIC HEAT ALARM. F S Palmer and L H Desisle.
14,223 COPPER. T Twynam.
14,227 PUDDLING, MELTING, HEATING, and OTHER FURNACES.* D Parry and B F Kelly.
14,228 COMPOUND CHECK VALVE. E J O'Brien.
14,229 INCANDESCENT ELECTRIC LAMP HOLDERS. H Stone.
14,234 NAVIGABLE VESSELS CONSTRUCTED to CONVEY LIQUID. G Jones and J F Flannery.
14,239 ELECTRICITY METERS. G Hookham.
14,241 IRON and STEEL MANUFACTURES. J Colley.
14,242 TRACTION and OTHER SELF-MOVING ENGINES. R H Fowler and G S Tuer.

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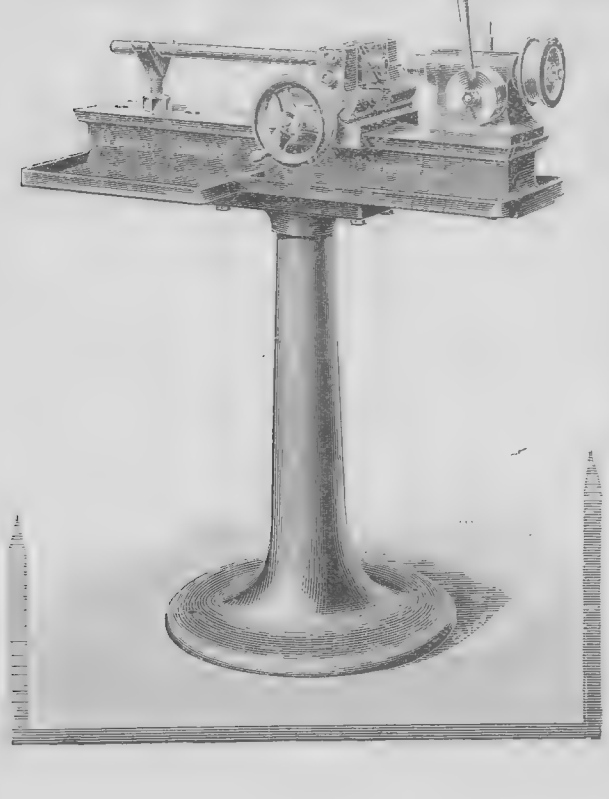

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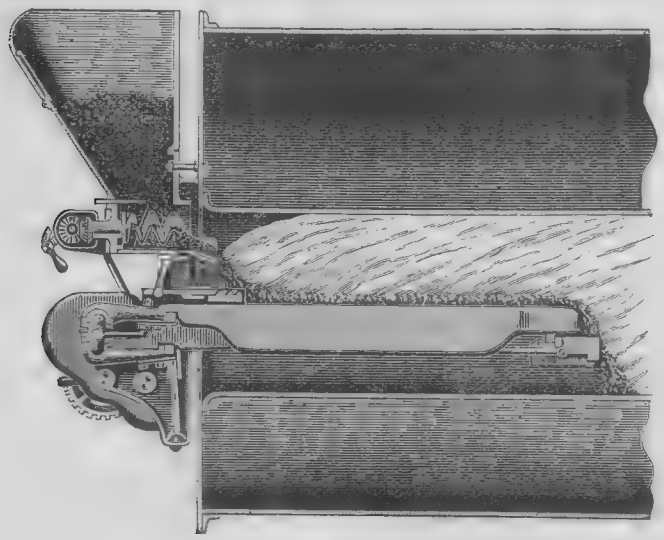

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FRIDAY, AUGUST 26TH, 1892.

Awards for Inventions Scheme.

IN these days of fierce competition it becomes more than ever necessary to keep ourselves on the alert for the purpose of taking advantage of any improvements upon the old processes or old machines that we had previously been accustomed to rely upon in the carrying out of our various industries. Yet the question arises in a reflective mind, Do we at the present time utilise to the fullest extent all the energy and inventive abilities we are capable of reasonably employing? We are inclined to think that we do not, and are therefore pleased when we have brought before us any scheme whereby the latent abilities of those practically engaged in any industry may be stimulated and utilised for the benefit of themselves and the community at large. Such a scheme we have had submitted to us by Mr. Gilbert Little, the enterprising manager of the New Conveyor Company, of London, who modestly acknowledges that in all points his scheme is not essentially novel, though he believes nevertheless that by the co-operation of those engaged in the gas-making industry (to whom he especially alludes) its validity may be assured. Mr. Little proposes the establishment of an Inventions Committee, to be elected annually in connection with the different associations of engineers and managers, whose functions it shall be to decide upon the merits of inventions or discoveries submitted to them, and to grant money awards from £5 to £200 or more, such awards to be given to any manager, foreman, or workman who proposes any change calculated to increase the utility of the machinery or render the products superior in quality or more economical in cost. Every claim for award on a successful invention is to be submitted to the committee, who shall then give due notice to all members of the association, and decide according to the opinion they may form of the value of the improvement what remuneration they shall give to the inventor. In cases where the invention is of very great merit the maximum award of £200 is to be given, in addition to the taking out, at the committee's expense, of patent rights in different countries on behalf of the inventor, provided that those who contribute to the Inventions Fund shall have the right, subject to a small royalty, to the use of the invention. This arrangement is not, however, to abrogate the right of the inventor to charge an increased royalty to those desirous of using the invention but who do not contribute to the fund. The awards are to be payable out of a fund subscribed to by the various corporations and gas companies and trading engineers, the rates of subscription varying from £10 yearly in the case of works carbonising under 2000 tons of coal per annum, to £500 for works carbonising 600,000 tons, whilst trading engineers are to pay £20 per annum. Power is reserved to the committee to award prizes for the invention or discovery of any specific principle or contrivance upon which they might deem it desirable to concentrate the inventive faculty of those engaged in the industry. There are several other minor clauses in Mr. Little's scheme to render it more effectual, but we trust that those parts of it which we have pointed out will be sufficient to show the meritorious character of the scheme as a whole. We should very much like to see it adopted, not only in the gas-making industry, but also in all other industries where it would be likely to render useful service in the direction indicated.

Electric Launches in Paris.

ELECTRIC LAUNCHES having become firmly established in this country, efforts are now being put forth to introduce this type of boat to the French. The first—the "Eclair"—has recently been tested on the Seine between Asnières and Epinay, by the representatives of Messrs. Woodhouse and Rawson, in the presence of some of the members of the French technical press. This launch is 36ft. long, 4ft. wide, and has a draught of 1ft. 6in. She carries 40 Epstein cells, and is fitted with a 3H.P. motor; the maximum speed is 7½ miles an hour. The launch, which will accommodate 20 persons, weighs 4 tons without passengers. When the cells are exhausted, they are recharged at Saint Ouen les Docks from a barge along which a branch cable is run from adjoining works. Arrangements are, however, being made for a supply of current from the Popp Co., and which it is said seem to indicate that other electric launches will be introduced in Paris.

The Lighting of Southport by Electricity.

IT cannot be denied that before long all our principal towns will adopt electricity as the medium wherewith to light their principal thoroughfares and buildings. The record of the march so far made in this direction is a most brilliant one, and as experience is gained it will undoubtedly continue to be so. The latest scheme is for the lighting of Southport. The plans have been prepared by Mr. G. Wilkinson, M. Inst. E.E., and were unanimously approved and adopted at the last meeting of the Town Council held on the 16th inst. The system to be adopted is the high-pressure alternating current one, and the generating station is to be erected on a site adjoining the present gasworks, 1½ miles out of the town. Duplicate trunk mains will be laid to transformer sub-stations in the town and residential district of Hesketh Park, where low-pressure distribution mains will be put down. The full equipment of the station will consist of three sets of horizontal engines and dynamos, each equal to an output of 100 units, two sets of 50 units each, and one of 25 units. Separate exciters will be used, and the alternators will be worked in parallel. It is proposed to supply electric current to consumers by meter at a charge of 6d. per unit, until the profits of the business justify a reduction.

The Problems of Commercial Electrolysis.

AN excellent example has been set by the Institution of Electrical Engineers in the sending round for publication in advance of proofs of a paper by Mr. J. Swinburne, on "The Problems of Commercial Electrolysis." With a subject of such wide application, a good opportunity is thereby afforded for the perusal of the paper beforehand, which will be taken during the next session, and so produce a discussion which cannot fail to be of greater interest than would otherwise obtain. In the paper a general view is given of the various sides of the subject. The author first deals with the decomposition of water for the production of oxygen, and then passes on to a branch which has attracted considerable attention—namely, the manufacture of caustic soda and chlorine from common salt. Mr. Swinburne urges that the only difficulty in the successful production of these two commercially, lies in the anodes, which corrode and become destroyed. After considering the manufacture of potassium chlorate and the electrolysis of fused salt and soda, the author comes to the extraction of metals—for instance, aluminium, magnesium, zinc, lead, gold and silver, and the electro-metallurgy of copper. The extraction and refining of copper form a very important application of electrolysis, and although the processes referred to—the Marchese, Siemens, and Höpner—are only briefly treated, yet further particulars are desirable and may be anticipated. References to electric tanning, the production of ozone, and the electric furnace are then made, and the author concludes by suggesting other directions in which electrolysis may play an important part. Among these may be mentioned improvements in the manufacture of white lead and aniline dyes, whilst "the extraction of gold from sea water, which is said to contain minute quantities, need hardly be treated seriously." The paper is extensive in its scope, and is an interesting summary of the present practical applications of electrolysis, tending to future developments.

A Severe Boiler Test.

WITH the continued progress towards the employment of triple-expansion engines for driving purposes on land, it is inevitable that the boilers should be constructed to withstand the increased pressure this class of engine requires. We have frequently in these columns referred to the advances made in this direction, and have now pleasure in directing attention to a very severe test of a boiler which took place at the works of Messrs. Hick, Hargreaves and Co. Limited, Bolton. The boiler has been designed by Mr. J. H. Tattersall, of Preston, for a firm of Kirkham manufacturers, and is intended to supply steam, at a working pressure of 170lb., to a set of engines which are at the present time being converted into triple-expansion. It is 30ft. long by 8ft. 6in. in diameter, circular seams double riveted, and longitudinal seams triple riveted. The top manhole frame is also triple riveted to the shell, with a strengthening ring inside the boiler. The seating blocks for the two stop valves, the Hopkinson safety valve and the blow-off elbow pipes, are double riveted to the shell and strengthening rings inside the boiler. The internal flues are 3ft. 5in. inside diameter, each flue containing fifteen rings of plates. The ends are stayed with longitudinal bolts and gusset stays; the latter are geometrically arranged, putting an equal amount of tensional strain on each rivet in the gusset stays. The mud-hole frame is steel, cut out of the solid, and is double riveted to the front end. It is elliptical in shape. The long axis is put vertical instead of horizontal, the usual way, thus allowing the gusset stays below the flues to be brought closer together, taking a firm grip of this vital part of the boiler front. The boiler was subjected to 300lb. pressure per sq. in. for a considerable time, and there was no bulging or distortion in any part while subjected to so severe a test. We understand that this is the eighth boiler of this special type for high pressure, and up to the present there has been no grooving in the furnace angle irons or in the shell end plates of the boilers previously supplied, which is a common result with the ordinary method of staying boiler ends.

Railway Accidents in 1891.

THE annual general report to the Board of Trade upon the accidents that have occurred on the railways of the United Kingdom during the year 1891 has just been issued as a Parliamentary paper. The number of persons reported as having been killed from all causes during the year under review was 1168, and injured 5060. Under the latter head all injuries are included, even those of a trivial character. Of the number killed 103 were passengers and 549 servants, and the remainder trespassers, suicides, and persons who were passing over level crossings. Of the injured 1612 were passengers, 3161 servants, and 287 other persons. In addition, the companies have returned 79 persons killed and 6440 injured from accidents which occurred on their premises but not connected with the movement of railway vehicles. Of 68 investigated train accidents, 9 occurred on the Caledonian, 6 on the Midland, 5 each on the Great Western, the Lancashire and Yorkshire, and the London and North-Western, 4 each on the Great Northern and the Great Eastern, 3 each on the London, Brighton, and South Coast, the Metropolitan, and the North British, and 2 each on the Glasgow and South-Western, the Great Eastern, the Great North of Scotland, the Highland, and the London, Chatham and Dover. Twenty-four railway servants were killed and 267 injured whilst employed in the coupling and uncoupling of vehicles, 136 were killed and 1404 injured whilst employed in various other shunting operations, 19 were killed and 64 injured by being caught between vehicles, 17 were killed and 75 injured by falling between trains and platforms, 115 were killed and 108 injured whilst working on the permanent way and sidings, and 146 were killed and 259 injured whilst walking, crossing, or standing on the line on duty. The accidents to persons passing over railways at level crossings show a considerable decrease on the somewhat high figures for the previous year, the numbers being 66 killed and 31 injured, against 83 killed and 35 injured in 1890. The number of trespassers was 306 killed and 161 injured, against 252 killed and 123 injured in 1890, or an increase of 54 killed and 38 injured. A number of valuable suggestions are made throughout the report.

THE zone system of fares has been introduced on the Cork, Blackrock and Passage Railway Company's lines, and has given great satisfaction. The company carried 10 per cent. more passengers in the past half-year than in the corresponding half last year.

HERR W. HAMPE states in "Chemiker Zeitung" that all the specimens of electrolytic copper which he has examined contained a small proportion of antimony, ranging from 0·007 to 0·02 per cent. The precipitation of antimony from the copper ore might be checked if the sulphuric acid electrolyte were not used for so long a time, and thus did not become so highly charged with impurities, but except for laboratory purposes the extra expense involved in the increased consumption of acid would not be proportionate to the advantages gained by the elimination of the antimony.

The Construction and Efficiency of Boilers of Locomotive Engines.

(*Continued from page* 68.)

In connection with boiler tubes, the author wishes to draw attention to an ingenious invention known as the Serve tube (Fig. 3). This tube has met with remarkable success in its application to marine and stationary boilers.* The result of some experiments made at the works of Messrs. John Brown and Co., of Sheffield, with this tube applied to a stationary boiler, showed an evaporative efficiency 15 per cent. greater

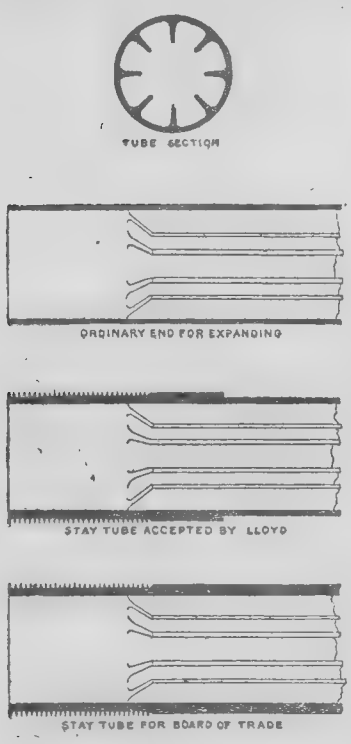


Fig. 3.

than that of a boiler of the same design, but fitted with ordinary tubes. The boilers of the s.s. "Pennsylvania" were fitted with Serve tubes, and the engines developed 1400I.H.P. as compared with 1200I.H.P., the maximum obtained in a sister ship that had her boilers fitted with plain tubes.

The main feature of the Serve tube is the projecting ribs which radiate from the inner side of the tube towards the centre throughout the length of the tube. The author is of the opinion that these tubes may be applied to locomotive boilers with satisfactory results. It is a recognised fact that the heating properties of plain tubes are affected by the

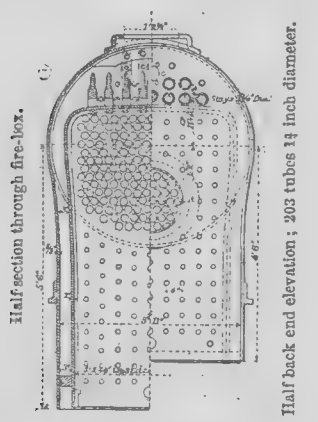
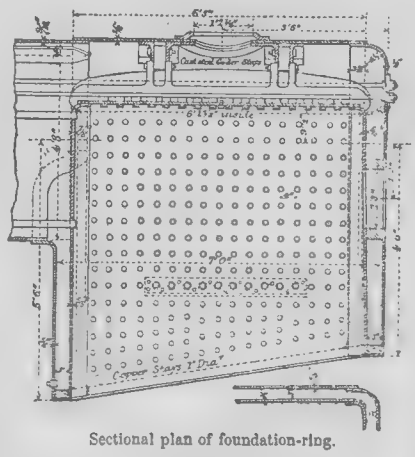


Fig. 4.

hot gases from the firebox passing up the centres of the tubes as cores, leaving a comparatively cool film of gas in contact with the surfaces. The result is, owing to the severe draught and short length of tubes in locomotive boilers, a high smokebox temperature, varying from 600° to 800° F., which means an unnecessary waste of heat. In the Serve tube the projecting ribs split up the gases, and, owing to the resistance offered by the ribs, compel the gases to travel slowly, the ribs absorbing the heat and conducting it to the water surrounding the tubes. It follows, in applying the Serve principle to locomotive boilers, that fewer tubes are required, thus compensating for the expense incurred through the extra weight of the tubes, and there is a better circulation of water due to the tubes being farther apart. The Serve tubes have been applied to 120 locomotive boilers on the Paris, Lyons, and Mediterranean Railway, and to several in England. Mr. H. B. Roelker has conducted experiments in America with these tubes, and reports most favourably upon them. It is said that they are too rigid for a boiler. The author thinks that such rigidity, if it exists, may be overcome by leaving out the ribs for about 12in. in length at the centres of the tubes, and bending them upwards.

In Figs. 4 and 5 there is another illustration of a North-eastern boiler, from the designs of Mr. T. W. Worsdell, M.Inst.C.E. It is similar to the design in Fig. 2, except that it has a larger firebox. The firebox shell is provided with four wash-out plugs and two mud doors, placed above the foundation ring. There are also four wash-out plugs placed in the smokebox tube plate. Care has evidently been taken to distribute the rivets uniformly and

Longitudinal section through fire-box.



Sectional plan of foundation-ring.
Scale ¾ inch = 1 foot.

Fig. 5.

neatly (Fig. 6), all longitudinal seams being in double shear. There are 203 brass tubes in this boiler, 1¾in. in diameter, $2\frac{7}{16}$in. pitch. The heating surface in the tubes is 1016 sq. ft., that in the firebox being 123 sq. ft. The fire-grate area is 20·7 sq. ft. The boiler supplies steam at a pressure of 175lb. per sq. in. to compound cylinders 20in. and 28in. in diameter respectively, and 24in. stroke. Neglecting the compounding and clearance, and treating the two cylinders as being each 20in. in diameter, there are 5 cubic in. of cylinder capacity to 1 sq. in. of grate area, 1 cubic in. of cylinder capacity to 9·8 sq. in. of tube-heating surface,

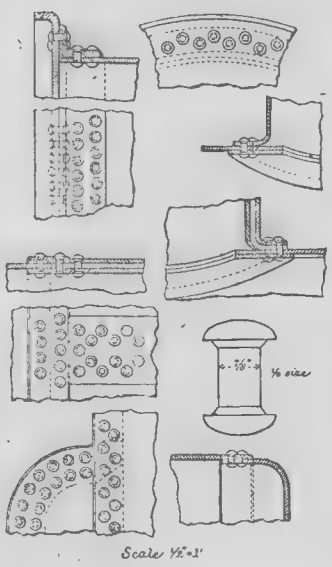


Fig. 6.

and 1 cubic in. of cylinder capacity to 10·87 sq. in. of total heating surface. The ratio of the contents of the cylinder to the grate area is, in this case, with the exception of the late Mr. Stroudley's "Gladstone" type of boiler, about the maximum in English practice.

In constructing a locomotive boiler, the usual method is to set out the barrel plates with the pitch of rivet holes, and then the plates are rolled circular. In the case of telescopic boilers, several holes are drilled, and the plates are held together temporarily by service bolts. When the circular seams are flush and covered with butt-strip rings, it is usual to slip the rings on hot between the plates, and allow them to contract over the joints. The butt-strip rings and tube-plate ring are then set out with the rivet pitches, and the whole of the boiler barrel is placed under the drilling machine. The longitudinal butt strips, having been previously heated and bent to the required radius on moulds are placed in position, and the whole of the rivet holes in the boiler barrel are drilled.

The back plate having been flanged is set out with the holes for the stays and fittings. The throat plate is treated in the same manner. It is advisable to make the throat plate a little thicker than the back plate, as the edges are drawn away, and the plate is subjected to the severe process of being flanged forwards to receive the barrel, and backwards to receive the firebox shell covering sheet. The firebox shell is fitted up from the foundation ring, the centres are accurately adjusted from the face or surface plate, and the edges of the back and throat plates are drawn away for the covering sheet to fit over. The firebox shell is then taken to pieces, and the different parts are drilled; the burr formed by the drilling on the inner sides of the plates is then removed, and the shell is put together and riveted in position to the boiler barrel.

When punching is resorted to, the holes are punched before the plates are rolled. This, in a great measure, accounts for the inaccuracy of punched holes when the plates are eventually put together; the plates also bend more readily at the holes, and are comparatively flat between them.

(*To be continued.*)

On the Applications of Electricity in the Royal Dockyards and Navy.

(*Continued from page* 46.)

Mirrors.—As regards mirrors, the qualities required are three:—First, that they shall project a cylindrical, sharply-defined, and homogeneous beam of light of great intensity and penetrative power; second, that when in operation they shall not be liable to crack by contact with water, in the form either of rain or of sea-water spray, or by a blast of cold air; third, that they shall resist the concussion caused by the discharge of heavy guns. These qualities should be combined at a moderate cost, if possible, although efficiency is the primary consideration. Thus far mirrors have been submitted for trial by six different English makers, and by others specimens are being prepared for future trial. From among these, at least one successful English specimen has been obtained which compares in all points favourably with the French production; and one half of the supply for the navy will this year be ordered from the firm producing this specimen.

Carbons.—With regard to English carbons, the results were for a long time disheartening; even after several attempts by the same firm none of the specimens submitted for test approached in efficiency those of French make. The three qualities required in good carbons are that they shall maintain a steady arc without flaming or excessive hissing; that they shall be perfectly pure and homogeneous in structure, and shall preserve a well-formed crater on the positive carbon and a well-formed point on the negative; and that the waste shall be steady and uniform, without cracking or crumbling. A certain amount of success has already crowned the persevering efforts of English manufacturers. Although the English carbons are not even yet fully equal to those previously obtained from France, it is hoped they will soon come sufficiently near that standard to make them acceptable for use in the Navy.

Projector Requirements.—The present service projector requires at least one man close to it, to direct the beam of light in any desired direction, and also to feed and adjust the carbons as necessary. This is a disadvantage, because the position of a search light is evidently one affording a good mark for an enemy's fire, and is a bad position for observing the object illuminated, and it would be an advantage if the projector could be entirely manipulated from a protected position at some distance—for instance, from the ordinary conning tower. For this purpose two requisites are necessary—first, a good automatic lamp; and second, an efficient motor for giving the necessary movements to the projector. It is to these two improvements that attention is now being given.

A good practical automatic lamp is the first necessity; without this a man must be stationed at the projector to feed the carbons, and, being there, he can also direct the beam of light. Several automatic lamps have been tested, but none have as yet been adopted for general use. One lamp, in which the carbons are regulated by a small electric motor in a shunt circuit, is promising; but in its final form it has not yet been returned from the makers. The field, however, is still open for invention in this direction.

Experiments have also been made with an electric motor attached to the service projector, by which the movements of the latter can be directed and controlled from a distance. The results are highly satisfactory, but as already stated the invention is not likely to be brought largely into use until it can be combined with a satisfactory automatic lamp. Recently a wheeled carriage has been introduced for using a ship's projector on shore.

2.—Incandescent or Glow-lamp Lighting.

Electricity is at the present day largely resorted to for the purpose of lighting internally the vessels of the navy; all the larger vessels, such as battle-ships and first and second-class cruisers, are now so lighted. Moreover, this mode of lighting is not restricted to the habitable portions of the ship, but is carried out to the complete exclusion of other modes, although the latter may be fitted as a reserve. Thus the electric lighting is extended to machinery spaces, coal bunkers, magazines, shellrooms, storerooms, gun quarters, etc., as well as to the illumination of compass cards, telegraph dials, bow and mast-head and signal lanterns, semaphores, etc. Clusters of glow lamps beneath an enamelled metal reflector are also employed for lighting the upper deck when coaling or other operations are being carried on at night. In a large battle-ship like the "Royal Sovereign" there would be about 800 of these glow lamps, necessitating for this system alone about 8 miles of electric leads, which are equivalent to something like 155 miles of copper wire of varying sizes, principally No. 20 legal standard wire-gauge, or 0·036in. diameter.

Progress.—The first installation of internal lighting in the Navy was carried out on board the "Inflexible" in 1881, by the Anglo-American Brush Company. It was a combined system of arc and glow lamps. The dynamos used were of the Brush type, of which the first specimen brought to this country was purchased by the Admiralty, and is still in use in Portsmouth dockyard. Each machine was capable of maintaining 16 Brush arc-lamps of 2000C.P. each. The lamps had double sets of carbons, each pair burning eight hours. These arc lamps were switched on and off by a switch opening and closing a shunt circuit of small resistance. With this plan it is evident a lamp could not be safely handled while the current was on, even if the light was switched off, because the lamp itself still formed a part of the circuit. A switch was accordingly devised in the dockyard, by means of which the lamp could be cut completely out of the circuit. The Swan glow-lamps were fitted in sets of 18 in series, each set being placed in parallel between the main circuits of the arc lamps. Each glow lamp was fitted with an automatic cut-out, bringing into the circuit a resistance equal to about that of the lamp, in case the latter failed. This system now no longer exists in the "Inflexible," an installation on modern methods having been substituted for it.

The five Indian troopships were next fitted throughout with glow lamps by the Edison Company, who used the Edison-Hopkinson type of dynamo, giving a current of 180 ampères at 110 volts. The "Polyphemus" was also entirely fitted by Messrs. Siemens, and the "Colossus" by the Brush Company, the dynamos in the latter being of the Victoria Brush type. The "Polyphemus" was the only ship in the Navy fitted on the single-wire system. Afterwards the adoption of internal lighting became general; all new vessels except the smaller cruisers were fitted, as were also the previous vessels on the first opportunity of their coming in for repairs and refit. There are now in the Navy about 300 vessels either fitted or being fitted with electric lighting, for search lights or internal lighting, or both.

Difficulties.—The earlier installations, although quite satisfactory so far as the illuminating effect was concerned, were certainly not satisfactory in regard to the endurance of the plant; in fact, they were a constant source of trouble, both the dynamos and the leads requiring frequent repairs or renewals. These troubles arose partly from faulty construction, and partly from the conditions necessarily existing on board ships of war, such as the necessity for placing the dynamos well down in the ship and under protection from shot, which relegated them either to the engine-room with its high temperature and moist atmosphere, or to

* "Engineering," October 31, 1890.

some other confined and ill-ventilated spot. Under these conditions the insulation soon suffered, and the machine quickly got out of action. The leads throughout the ship suffered, too, from access of salt water, which caused much trouble by destroying the insulation and producing short circuiting, thereby frequently setting on fire the wood casing in which the leads were laid, or any other inflammable material in the neighbourhood.

Remedies.—Nearly all these difficulties have in the course of time been surmounted. While it is still necessary to place dynamos under protection for use in action, it has now become the practice to fit an additional dynamo, capable of running all the lights generally required at one time, and to place it, with its motor, in an open space between decks, or on the upper deck, suitably sheltered. This is known as the peace or daylight dynamo. The introduction of lead-coated wires marked an epoch in ship lighting; and these wires are entirely used in all the later installations, and are taking the place of the old leads as fast as the latter require renewal. These cables dispense entirely with the wood casings previously used, resulting in greater simplicity of fitting as well as increased efficiency. The wood casings are still in use in America, even with the lead-coated cables; but in the writer's opinion, while adding largely to the cost of the installation, they are likely to detract from its efficiency, as they form such convenient receptacles for water to lodge in.

Dynamos.—The Admiralty have not adhered to any one particular kind of dynamo; for although those of the Siemens type predominate in the Navy at present, nearly all the well-known makers are represented—such as Latimer Clark, Muirhead and Co., the Electric Construction Corporation, the Silvertown Indiarubber Co., Goolden and Co., Crompton and Co., and Parsons and Co. The experience gained in the testing and use of these machines of different types was of immense benefit in enabling those points to be discovered in which dynamos are most likely to fail, and in suggesting the direction which improvements should take. The weak points in most of the machines supplied were imperfect insulation, owing to want of sufficient care in building, and the excessive internal heating of the armature. In some cases the section of copper used was too small, resulting in the heating of the dynamo and the rapid destruction of the insulation. By direction of the Admiralty, a design was prepared by Mr. Lane, electrician of Portsmouth dockyard, for a machine to give an output of 400 ampères at 80 volts, which should embody the experience already gained, and should be free from the faults previously mentioned. Five machines have been built from this design, two of them for the "Rupert," a vessel now under reconstruction. No opportunity has yet occurred for testing them under the conditions of sea service; but two have been used for about a year under full load as temporary lighting plant for ship building, etc. At times, too, they have been worked for long periods above full load, from 420 to 430 ampères, and they have always given perfect satisfaction. They are driven at about 330 revolutions a minute by open vertical compound engines of 56 I.H.P., designed and constructed in the chief engineer's department of the dockyard. The total weight of the dynamo and engine with bedplate is about 5½ tons.

Other Fittings.—As regards the other fittings required to complete a successful installation—such as switches, fusible cut-outs, lamp-holders, shades and their holders, etc., patterns have been adopted or devised in accordance with accumulated experience to meet the special requirements of the Navy; these are simplicity, combined with strength to withstand the rough usage necessarily experienced on board a fighting ship. The guiding principle in the present installations is to make every part of the circuit inaccessible to water by employing lead-coated cables, and by enclosing in metallic water-tight boxes all the principal switches and cut-outs, and by effecting in all cases in the interior of water-tight distributing boxes the subdivision of the mains, which themselves pass into the boxes and their subdivisions out of the boxes through water-tight stuffing glands.

Switchboard.—With several dynamos and a combined installation of incandescent and search lighting a good switchboard is a necessity. The one generally used in the Navy at present is susceptible of improvement; and a new switchboard has just been designed and made by Mr. Lane, the dockyard electrician, which promises to fulfil all the requirements.

(To be continued.)

Machine Construction.

THE CONSTRUCTION OF MACHINE ELEMENTS.

(Continued from page 57.)

II.—The Load Acts Inclined to the Axis.

The construction is similar to L, except that the force and cord polygons are inclined according to the direction of Q. The vertical projections *a* A, and 3 *c* (Fig. 393) give the journal pressures P_1 and P_2; the horizontal component of Q gives the axial thrust.

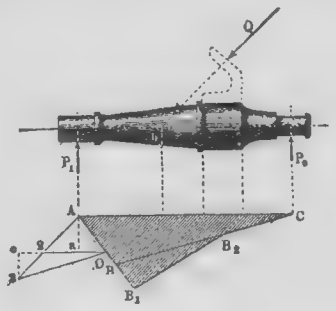


FIG. 393.

Another example is given in the case of a rod worked from an overhung arm, as in some forms of locomotive feed pumps, Fig. 395. The directions are here periodically reversed, and the relations of the points continually changing.

III.—The Load Acts Parallel to the Axis.

We here have two couples: one consisting of the two equal journal pressures, and the other of the two pressures at the ends of the hub-seat (see § 38). Draw the lines A B_1 and C B_2 (Fig. 394) parallel to each other, to intersect perpendiculars dropped from the ends of the hub, join B_1 with B_2, and the surface of moments is A B_1 B_2 C. To find the forces, prolong Q from B until it intersects C *b*, join it to the middle of the other journal, make *q b* = Q, and drop the perpendicular *q a*, which is equal to P. Make A 1 = P, draw 1 O parallel to A C, and O 2 parallel to B_2 B_1, then 1 2 is the force at b_1, and 2 1 that at b_2. If the hub should overhang, as in the case of a screw propeller, Fig. 396, the diagram takes the form A B C_1 C_2.

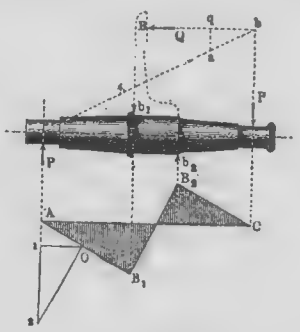


FIG. 394.

This may readily be done graphically by the method given in § 28. In order to compare such a diagram with one of the surface of moments as just discussed, it is necessary to construct them to the same scale. For this purpose take the origin O (Fig. 397) of the two axes X and Y, and make O *a* equal to the diameter (or semi-diameter) of the shank of the axle, and lay off, below the corresponding value O *b* of its ordinate t_1, draw on *a l* a semi-circle *a c b*, draw *a e* normal to *a c*, and taking O *e* as unity we have O *b* = (O *a*)³. Make O 1 = y, O 2 = y_2, etc., and draw the moments to the axes of X and Y, as 1, 1′, I., 2, 2′, II., etc., and we have O I, O II, as the desired values of y_1^3, y_2^3, which correspond to those of the principal diagram.

Such proof diagrams are very convenient to show what approximations may be made, and to detect possible errors in calculation, and show at once any deficiency in security, since the relation of the actual stresses to the desired constant stress is that of the ordinates of the proof diagram to those of the theoretical surface of moments. This numerical series may be plotted in a curve, called the stress curve. By combining the theoretical diagram with the proof diagram on an exaggerated scale, as shown in the illustration, the unit can be chosen to a greater advantage.

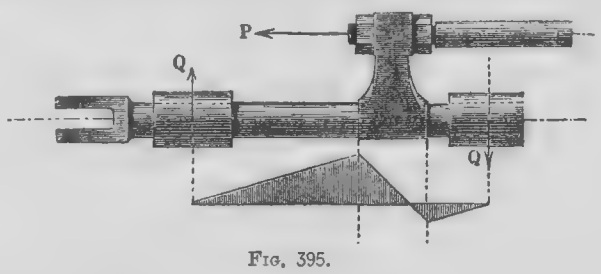


FIG. 395.

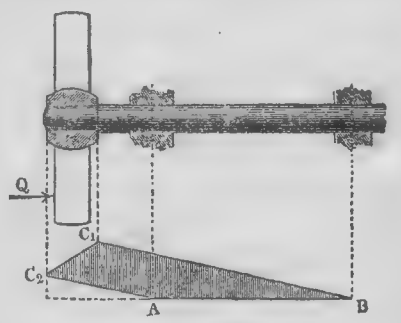


FIG. 396.

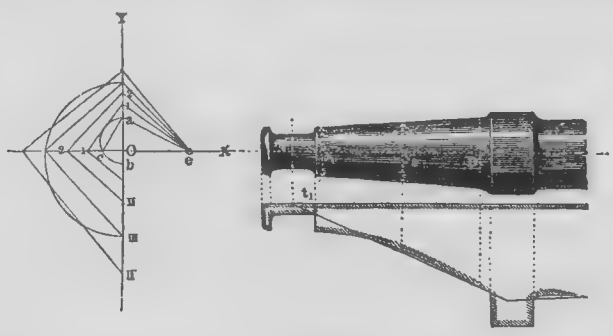


FIG. 397.

PROOF DIAGRAMS.

In order to calculate the resistance of a given axle to bending it is necessary to know the section modulus at various points. If all the sections are circular the moduli vary as the third power of the diameter. Hence the various diameters are to be cubed.

(To be continued.)

The British Association.

(Continued from page 72.)

Teledynamic Transmission.—First, then, let me say a few words as to modes of distributing power which it is possible to adopt. In 1850, at Logelbach, in Alsace, M. Ferdinand Hirn used a flat steel belt to transmit power directly a distance of 80 metres. Subsequently a wire rope was used on grooved pulleys. This worked so well that a second transmission to a distance of 240 metres was erected. The details of the system were worked out with great care with a view to securing the least cost of construction, the least waste of energy, and the greatest durability of the ropes. So successful did this system of teledynamic transmission prove that within 10 years M. Martin Stein, of Mulhouse, had erected 400 transmissions, conveying 4200H.P., and covering a distance of 72,000 metres. Just at this time a very able and far-seeing manufacturer at Schaffhausen, Herr Moser, had formed a project for reviving the failing industries of the town by utilising part of the water-power of the Rhine. Hirn's system of wire-rope transmission rendered this project practicable. The works were commenced in 1863. Three turbines of 750H P. were erected on a fall which varies from 12ft. to 16ft., created by a weir across the river. From the turbines the power is transmitted by two cables, in one span of 392ft., across the river. Similar cables distribute the power to factories along the river bank. In 1870 the transmission extended to a distance of 3400ft. Power is sold at rates varying from £5 to £6 per horse-power per annum. In 1887 there were 23 consumers of power, paying a rental of £3500 per annum for power. The project has been financially successful, and is still working. At Zurich, Freiberg, and Bellegarde there are similar installations, and a large scheme of the same kind has recently been carried out at Godak, in India. Wire-rope transmissions are of great mechanical simplicity, and the loss of power in transmission is exceedingly small. They are extremely suitable for certain cases where a moderate amount of power has to be transmitted a moderate distance to one or to a few factories. On the other hand, they become cumbrous if the amount of power transmitted exceeds 600H.P. or 1000H.P. The wear of the ropes, which only last a year, has proved greater than was expected, and is a source of considerable expense.

The practical introduction of a system of distributing power by pressure water is due to Lord Armstrong. Such a system involves a central pumping station, a series of distributing mains, and suitable working motors. From its first introduction the peculiar advantages of this system for driving intermittently working machines, such as lifts, dock machinery, railway cranes, and hauling gear, became obvious. But, with intermittent working machines, there arose the need of an appliance for storing energy during periods of minimum demand and restoring it in periods of maximum demand. The invention of the accumulator by Lord Armstrong made the system of hydraulic transmission a success, and at the same time fixed its character as a system specially adapted for those cases where intermittent work is required to be done. Lord Armstrong's system of hydraulic distribution by water at a pressure of 700lb. or 800lb. per square inch, with the use of accumulators for equalising the variations of supply and demand, has now been widely adopted. The most extensive scheme of that kind hitherto executed is the important scheme carried out by the Hydraulic Power Company. Over 50 miles of pressure mains have now been laid in the streets of London. The Falcon Wharf pumping station contains four sets of compound pumping engines, each of 200H.P. Two additional pumping stations have now been erected, and 1500 lifts are worked from the pressure mains. The minimum charge for water is 2s. per 1000gals. This rate of charge is economical for such machines as lifts, but it would be extravagant for machines working continuously. It would be equivalent to a charge of nearly £50 per horse-power per year of 3000 working hours, apart from interest and maintenance of machines.

I shall indicate later on that in some cases where local conditions are favourable, where there is cheap water-power and the possibility of constructing high-level storage reservoirs, then hydraulic transmission can be adopted with success for distributing power for ordinary manufacturing purposes. But neither teledynamic transmission nor hydraulic transmission have proved suitable as methods for the general distribution of motive power from central stations. Distribution by steam and distribution by heated water have both been tried in the United States, but not with very remarkable success. Only two other methods are available, distribution by compressed air and distribution by electricity. For many years compressed air has been used to distribute power in tunnelling and mining operations to considerable distances. It is only recently that it has been used as a general method of distributing power to many consumers. In many installations the machinery has been rough and unscientific, and the waste of energy very considerable. It is through experience gained and improvements carried out in the remarkable system now at work in Paris, and known as the Popp system, that the great advantages of compressed air distribution have been proved. The Paris system has very gradually developed. About 1870 a small compressing station was erected to actuate public and private clocks by intermittent pulses of air conveyed along pipes chiefly laid in the sewers. In 1889 about 8000 clocks were thus driven. Meanwhile the compressed air had also been applied to drive motors for small industries. The demand for power thus supplied grew so rapidly that a [illegible] compressing station was built [illegible]

de Saint Fargeau. In 1889 steam air compressors of 2000H.P. were at work, and additional compressors were under construction. The pressure at that time was five atmospheres, and the largest air mains were 12in. in diameter. Ingenious and simple rotary machines were used as air motors for small powers, and for larger powers any ordinary steam engine was converted into an air motor. Prof. Kennedy made tests in 1889, which were communicated to this association. He found that a motor four miles from the compressing station indicated 10H.P. for 20I.H.P. expended at the compressing station, an efficiency of 50 per cent. only. There were then 225 motors worked from the air mains. Since 1889 more extended investigations have been made by Prof. Riedler, of Berlin, and the chief part of the waste of work has been traced to inefficiency of the air compressors. Compound air compressors of much higher efficiency have now been constructed. The plant at the St. Fargeau station has been increased to 4000H.P. A new station has been erected on the Quai de la Gare, intended ultimately to contain compressors of 24,000H.P. Compressors of 10,000H.P. are already under construction. Compressed air transmission, whether or not it is the most economical system, is undoubtedly applicable for the distribution of power on a very large scale and to very considerable distances. There is nothing in any of the appliances which is novel or imperfectly understood. The air is used in the consumer's premises in machinery of well-understood types, and old steam engines can be converted into air motors without difficulty and without alteration of existing transmissive machinery in the factories. Not least important, the air can be measured with accuracy enough for practical purposes by simple meters, and charged for in proportion to the power consumed. Air compressors and air motors are not as efficient as dynamos and electric motors, but in one respect distribution by air and electricity are similar. For distances which are not more than a few miles the loss of energy in transmission is small enough to be insignificant.

There is yet one other mode of power distribution, which promises to become the most important of all, and which, in the case of transmission to very great distances, if such transmission becomes necessary, has undoubtedly great advantages over every other method.

About electrical distribution of power I shall not venture to say much, partly because I am not an electrical expert, and partly because it has been lately pretty fully discussed. In the United States there has been an enormous development of electric tramways, which are essentially cases of electric power distribution. In this country we have the South London and some other railways worked electrically. There are others also on the Continent. But electrical power distribution to private consumers for industrial purposes has not yet made as much progress as might have been expected. Perhaps electrical engineers have been so busy with problems of electric lighting that they have had no time to settle the corresponding problems of power distribution. No doubt continuous-current distribution presents at the moment the fewest difficulties, or, at any rate, involves the fewest comparatively untried expedients. Several continuous-current plants for distributing power are in operation, of which, perhaps, the most interesting is that at Oyonnax, which was described in Section G last year by Professor G. Forbes. There 300H.P., obtained by turbines, is transmitted 8 kilometres at 1800 volts. It is then let down by motor transformers to a voltage suitable for lighting and driving motors. A number of small workshops are driven, the power being supplied at a fixed rent. At the Calumet and Hecla mines on Lake Superior, at the Dalmatia mines in California, and at some other places, energy derived from turbines is transmitted distances of a mile or two by continuous electric currents and used in driving mining machinery, and some cases of the use of electrical distribution in mines in this country were mentioned by my predecessor in his address last year. At Bradford a few electric motors are being worked from the electric lighting mains. The largest of these is of 20H.P. The price at which the electricity is supplied is not given, but I believe the cost is high when reckoned for continuous working. It would seem that it must be so when the electric current is generated by steam power. At Schaffhausen an electric transmission has now been constructed alongside of the wire rope transmission. The power is derived from two turbines, and is transmitted across the Rhine, a distance of 750yds., at 624 volts. The current drives a spinning mill, in which the largest motor is 380H.P. The power is sold, I believe, at £3 per horse-power of the motors per annum.

Many engineers have now apparently come to the conclusion that alternating currents will be better for power transmission to considerable distances than continuous currents. One interesting alternate-current transmission, partly for power, partly for lighting purposes, has been for some time in operation in Genoa. On the line of the aqueduct bringing water from the Gorzente rivulet three electric stations are being established. The reservoirs are 2050ft. above Genoa, and as this is a much greater fall than is required for water-supply purposes, part can be used to generate 1600H.P. In the first of the power stations erected there are turbines of 450H.P. driving two dynamos. A second larger station was completed in November. In this there are eight alternate-current dynamos of 70H.P. each. Six alternators are worked in series, transmitting a current of 6000 volts. The current is transmitted 16 miles by bare copper wires, 8·5mm. diameter, placed overhead. The current is used both for lighting and power purposes. Another method of using alternating currents was adopted in the remarkable experiment at Frankfort last year. In that case energy obtained by turbines at Lauffen was transmitted to Frankfort, a distance of 108 miles, and used for lighting and driving a motor. The current was obtained at low tension, transformed up to a tension of 18,000 to 27,000 volts for transmission, and then transformed down again for distribution. The loss in the conducting wires ranged from 5H.P. when the turbines worked at 100H.P., to 25H.P. when the turbines worked at 200H.P. The efficiency of dynamo, two transformers, and line ranged from 68 to 75 per cent., a remarkably satisfactory result. There can be little doubt that if efficient and durable transformers can be constructed, they do give considerable advantage to an alternate-current system. To an ordinary engineer it appears also that the system of producing current at low tension in the dynamo, and using it at low tension in the motors, permits of the construction of dynamos and motors more mechanically unexceptionable than those working at high voltage.

(To be continued.)

Famous Firms.

(By Our Special Correspondent.)

MESSRS. RUSTON, PROCTOR AND CO. LIMITED, LINCOLN.

(Concluded from page 66.)

THOUGH boilers of the locomotive type for portable and semi-portable engines are chiefly made here, boilers of most kinds may be seen in process, including Lancashire, return flue tubular, and vertical of several kinds. Large orders from the Indian Government were in hand. The work generally is so far done by machinery that the same kind of work must go into all, big or little. All holes are drilled in shells and inside fireboxes. For the shells large drilling machines are in use. Once slung into place, within command of the drill-heads of either of these machines, a boiler shell is soon ready for its rivets. These very useful drilling machines have been specially made by the firm to suit the requirements of the work. For riveting, fixed hydraulic riveters are used, as well as a couple of portable riveters, whilst compressed-air riveters are used for girder work.

The long plates which form the sides and top of a locomotive boiler firebox are bent by means of a hydraulic press of simple yet very ingenious design. The machine consists of a frame sufficiently wide to hold almost any size of firebox plate, having a couple of hydraulic rams in the middle. These rams have two dies, V-shaped, fitting one into the other. A plate is slipped in, the water turned on, and instantly the plate is bent as desired. There were some large planing machines for boiler plates doing good work.

In the moulding shop things were very brisk, some 190 men being at work. Fifteen to twenty tons of metal are cast each day, and it is possible to turn out a seven-ton casting at one operation.

Crossing over to the "malleable" side, we find, owing to the press of work, matters very crowded, and considerable extensions will have to be undertaken. Our attention was first drawn to a hydraulic testing machine, in which some malleable castings picked up at random were tested in our presence. The ram, 3in. diameter, giving a pressure of 25 tons to the square inch, failed to break them—a fact which affords a strong proof that Messrs. Ruston believe in and use good stuff only.

After a look at the furnaces for annealing, and a glance at the brass foundry and pattern shop—one of the best fitted-up places of the kind we have seen,—we go on to the fitting, turning, and erecting shops.

These shops were, perhaps, the busiest parts of the works, and here, as elsewhere, the tools were of the latest and best design, many of them being specialities of the firm. Machines of various kinds for labour-saving are in very general use. Amongst these are a lathe for turning four piston rods at one time, a machine for boring out the brasses in six plummer blocks at once, for boring four small cylinders, and so on. In the larger turning shop we noticed a large number of milling machines. We also remarked a machine made by the firm to shape out between the horizontal and vertical flanges of brasses at one setting. Everything possible is done by machinery, and the men being intelligent soon learn to use it. The result is that Messrs. Ruston, Proctor and Co. produce good machinery, well fitted and well finished, containing plenty of material, and they do this without wasting any money on hand work which can be better done by ingenuity applied to machine tools.

Amongst the numerous special machines used specially in the erecting shops and turnery, the simple drilling apparatus and lifting and turning gear, by means of which the portable engine boilers are lifted, drilled, and turned about as desired by the erectors, are worthy of mention. In the erecting shop is a strong vertical boring machine, adapted to the work of shaping the bottom of portable engine cylinders where they sit on the boilers. The bar is fitted with a tool head, and the cylinder to be shaped, after being marked or set out by the erector, is fitted to the circular bed of the machine. It is set so that the revolving cutter or cutters give it the necessary sweep, and any slight variations required are easily allowed for by the machinist, who can adjust the circular bed as the work goes on. Thus in less than an hour what used to take about four to six hours years ago is now easily accomplished. A machine for cutting keyways in fly-wheels was also pointed out. In this machine the fly-wheels stand vertically, and a horizontal tool holder works backward and forward within the bore of the wheel, which stands on a platform adjustable to the size of the wheel. A large lathe, taking a 20ft. fly-wheel, is a very prominent object here. Amongst the engines in course of construction, a large one for the Brazils and a very fine pumping engine for South Wales well show the beauty of the work turned out. There are about 600 men employed in the shops above referred to, and in the turnery alone there are over 300, with over 80 fitters and turners, for brass fittings and like work.

After a walk through the testing and paint shops, our inspection of the engineering portion of the works came to an end. Mr. Weatherley tells us that the firm turns out some thousand engines and 600 thrashing machines each year, besides other machines, such as steam navvies—the latter being a branch of work in which Messrs. Ruston, Proctor and Co. have achieved marked success.

And now we go across the city to the wood and the thrashing machine works. Here the enormous extension lately made show better than any amount of description could do the success which has attended Messrs. Ruston, Proctor and Co.'s policy of turning out only high-class goods. The saw-mills and the wood-working department are probably unexcelled in the kingdom, so perfect is the system on which they are worked.

In the wood-working shops the machinery is all driven by belts from countershafting under the floor, and the refuse—shaving and sawdust—is carried by means of an exhauster through a pipe some 15in. diameter direct to the boiler house, where it is utilised in place of coal for heating the boiler, which drives a compound vertical condensing engine.

In the yard somewhere about £80,000 worth of timber was stacked. This consisted principally of oak, ash and red deal, the first being used for the frames of the thrashing machines, the second for the undergear, and the deal for the sides. It is all dried naturally in the tree, which ensures that all the parts of the machine shall remain true, no matter how long it may be in use.

The forging and casting of the iron work required are done at the ironworks, the turning being done here. The turning shop was simply packed with tools, and everyone of them was at work. So busy is the firm that no machine is stocked. We saw in various stages of construction a couple of hundred machines, every one of which was ordered.

The firm's thrashing machines are sent all over the world. We saw some ready for shipment for Riga, Bucharest, Hesse, and Berlin, and many others were being finished with all speed for even more distant destinations. The output is 50 machines a fortnight.

We must forbear describing the ingenious tools at work here on various parts of the machines. Suffice it to say that the work done by some of them was remarkable.

With many thanks to Mr. Weatherley for his painstaking kindness, we must now perforce conclude this short and necessarily incomplete account of our visit to the works of Messrs. Ruston, Proctor and Co.

The Iron and Steel Institute.

THE autumn meeting of the Iron and Steel Institute will be held at Liverpool during the three days beginning on September 20. A reception committee has been constituted in that city under the presidency of the mayor (Mr. Debels Adams). The programme includes visits to the Liverpool docks and warehouses, to the overhead railway now in course of construction, to the principal ocean steamships in the docks, to the Mersey Aqueduct Tunnel Works and Norton Water Tower, to the Manchester Ship Canal Works, to the shipbuilding works of Messrs. Laird at Birkenhead, and to other works in the district. The papers to be read include one by Mr. Greathead, on "The Liverpool Overhead Railway." Mr. Greathead, who is the engineer of the London Electric Railways, will illustrate his paper with diagrams showing the modes of construction. A paper on "The Walker Engineering Laboratories at Liverpool" will be read by Professor Hele-Shaw. Sir Lowthian Bell will contribute a paper on "The Condensation of Ammonia from Blast Furnaces," which is being carried out at several of the more important iron-producing districts of the United Kingdom, with results that are stated to be satisfactory. A paper on "The Manufacture of Steel in Austria" will be read by M. Kupelweiser, of Witkowitz; and other papers on "Alloys of Iron and Chromium" and on "Sulphur and Iron" will be read by Mr. Hadfield, of Sheffield, and Mr. Stead, of Middlesbrough. Prof. Roberts-Austen, of the Royal Mint, will also read a paper on "An Appliance for Autographically recording the Temperature of Furnaces."

Shipbuilding Notes.

Messrs. Robert Ropner and Sons, of Stockton, have enlarged their shipbuilding yard, and will now be able to have six vessels on the stocks at the same time.

Messrs. R. Duncan and Co., shipbuilders, Port Glasgow, have contracted with Mr. Robert R. Paterson, Greenock, to build a steel ship of 3600 tons carrying capacity.

The "Marblehead," the eleventh cruiser constructed for the United States Government, was launched at Boston, U.S.A., on the 11th inst. Her length is 257ft., and her breadth 37ft.

Messrs. Russell and Co. launched from Kingston yard, on the 18th inst., a four-masted steel sailing ship of 2330 tons, to carry 3800 tons. The dimensions are:—Length, 283ft.; breadth, 43ft.; depth, 24ft. 3in.

On the 13th inst. the steamer "Don," built by Messrs. William Dobson and Co., of Low Walker-on-Tyne, was taken to sea to run her speed trials on the measured mile, when a mean speed of 12½ knots per hour was obtained. The dimensions of the vessel are:—Length, 235ft.; beam, 33ft.; depth, 16½ft.; and the triple-expansion engines have cylinders 19in., 32in., and 52in. diameter by 36in. stroke.

On the 17th inst. the "Tropea," a large cargo steamer built by Messrs. R. and W. Hawthorn, Leslie and Co., had a highly satisfactory trial at sea. The dimensions are:—360ft. by 46ft. by 30ft. moulded, and she carries 6500 tons deadweight. The engines, which have been constructed by Messrs. Welford Bros., have cylinders 25in., 40in., and 68in. by 45in. stroke, and steam is supplied by two double-ended and two single-ended boilers.

The contract-built cruiser "Sappho," 3400 tons, 9000H.P., has been received at Chatham Dockyard from her builders, Messrs. Samuda Brothers, Poplar, and is to be at once taken in hand and completed, in readiness for being commissioned. She will be fitted with an armament consisting of one 5in. gun with right-ahead fire, six 4·7in. guns, and nine 3-pounder quick-firing guns; and with engines giving nearly 3H.P. to every ton of displacement, and a speed of upwards of 19 knots.

Watertight Sub-division of Ships.

[CONTRIBUTED.]

(*Concluded from page* 61.)

We shall now proceed to illustrate the inefficiency of pumping power to stay such a calamity if the hole be of great magnitude, taking as an example the case last quoted.

For this we will assume our vessel to be well supplied with pumps, and consisting of the following :—

	Number.	Total Discharge per hour. Tons.
Centrifugal pumps	2	2000
Fire engines	2	300
Auxiliary steam pumps	2	1700
Friedmann's ejectors	4	1200
Bilge donkey pumps	2	100
Hand pumps, Stone's	4	100
		5400

The total pumping power will be 5400 tons per hour, which will give $\frac{5400}{60 \times 60} = 1\frac{1}{2}$ tons per second.

Now supposing the vessel in question to be bilged at a distance of 9ft. below the water-line, the area of the hole being 3sq. ft., the formula for estimating the velocity of inflow in cubic ft. per second is—

$$S\sqrt{d} \times A,$$

where A = area of hole in sq. ft., and d = depth of centre of gravity of hole below the water-line.

$$\therefore S\sqrt{9} \times 3 = 72 \text{ cub. ft.}$$

And taking sea water at 35 cub. ft. to the ton, we have $\frac{72}{35} = 2\ 05$, say 2 tons per second.

This is an approximate rule, but of sufficient exactness for our purpose.

It will be seen from the foregoing that the pumps would be useless in keeping back such a rush of water. To obtain the area that our pumping power could cope with until a leak stopper was applied we proceed as follows :—

Total discharge of pumps = $1\frac{1}{2}$ tons per sec.

" " = $52\frac{1}{2}$ cubic ft.

And $S\sqrt{d} \times A = 52\frac{1}{2}$

$= S\sqrt{9} \times A = 52\frac{1}{2}$

$= 24\ A = 52\frac{1}{2}$

$\therefore A = 2\ 18$ sq. ft.

Thus with a hole 2sq. ft. in area the pumps would be enabled to keep the rush of water under. The area here taken may be considered as somewhat small, and which, in case of collision or penetration by rocks, would most probably be exceeded; but it tends to prove that with a hole of larger dimensions the pumping power would be inadequate.

In conclusion, we will illustrate the subdividing of a few noted liners of the mercantile marine, also that of some warships of the royal navy. Taking the mercantile marine we have :—

Reference Letters.	Name.	Line.	Length.	Breadth.	Tonnage.	Number of Main Compartments.
			Ft. In.	Ft. In.	Tons.	
A	"Umbria" and "Etruria."	Cunard	500 0	57 0	8,000	10
B	"Belgic."	White Star	420 0	42 0	4,500	8
C	"City of Paris" and "City of N. York."	Inman	560 0	63 3	10,500	15
D	"Teutonic."	White Star	582 0	57 6	9,685	12
E	"Friesland."	Red Star	450 0	51 3	6,700	10
F	"Fürst Bismark."	Hamburg American	502 6	57 6	8,716	See foot note.
G	"Doune Castle" & "Lismore Castle."	Castle	410 0	43 0	4,050	9

REFERENCE.

A. These vessels are fitted with watertight and fireproof doors, so that each compartment may be isolated in case of accident; also in accordance with Admiralty requirements as regards employment in time of war.

B. Fitted similarly to above.

C. The bulkheads are continued to upper deck without any doors in them, thus the chances of their not being closed from oversight in time of accident are avoided. Also fitted with a double bottom. The engine-rooms are divided by a longitudinal bulkhead.

D. This vessel has a longitudinal bulkhead extending from after-end of engine-room to fore-end of foremost coal bunkers, dividing six of the largest compartments. The watertight doors are automatic rapid-closing, and may also be closed by hand. Built to Admiralty requirements as regards employment as armed cruiser in war time.

E. The doors in the bulkheads are placed about 8ft. above the load water-line, so that the chances of water finding its way into adjacent compartments in the event of accident are remote. The spaces are comparatively small. Fitted also with a double bottom.

F. This vessel has a longitudinal bulkhead from upper deck to keel, thus completely dividing it into two halves. These are non-communicating—*i.e.*, have no doors in them. Fitted with double bottom.

G. In these vessels the bulkheads extend from top of double bottom to upper deck. Also fitted with two complete steel watertight decks and a double bottom.

In most of these cases the main divisions are again divided into smaller spaces by means of horizontal flats or decks, reducing the chances of any serious accident from bilging to a minimum.

In the royal navy we have the following armour clads :—

Name.	Description.	Length	Breadth.	Displacement.	Total Number of Comp'rtments
		Ft.	Ft. In.	Tons.	
"Warrior"	Broadside.	380	58 0	9,035	92
"Resistance"	do.	280	54 0	6,270	92
"Minotaur"	do.	400	59 6	10,311	89
"Achilles"	do.	380	58 3	9,484	106
"Hercules"	do.	325	59 0	8,700	61
"Monarch"	Turret.	330	57 6	8 300	73
"Sultan"	Broadside.	325	59 0	8,899	67
"Devastation"	Turret.	285	62 2	9,062	104
"Alexandra"	Broadside.	325	63 9	9,490	115
"Dreadnought"	Turret.	320	62 3	10,164	101
"Téméraire"	Barbette and Broadside.	285	62 0	8,510	84
"Inflexible"	Turret.	320	75 0	11,100	135

The above gives the total numbers of watertight compartments—viz., those as main, wings, and double bottom divided by the flats, transverse and longitudinal bulkheads.

The doors are so fitted that they may be closed quickly, generally from decks above the load water-line, but in some cases they may also be closed locally. Also fitted with automatic valves where the bulkheads are pierced by ventilating trunks, etc.

The ships enumerated range from the "Warrior," in 1860, to the "Inflexible," 1876. The number of watertight spaces not being greatly increased from this until the new battle ships building under the Naval Defence Act, and these being of greater dimensions, the watertight compartments have been considerably increased in number.

WATERTIGHT.

The Utilisation of the Energy of Flowing Water.*

The energy of falling water has long been employed for motive purposes, and there is a widespread opinion that one of the great problems of the future is the conversion also into useful work of the immense power now running to waste in river and tidal currents. The authors believe that the discussion of any practical means of securing even a moderate portion of this force will be of considerable interest.

It is not necessary before this association to dwell upon the economy effected by the use of water power where it exists under favourable conditions.

A rough general measure of the commercial value of water as compared with steam power would be the price paid for water rights.

Notwithstanding the natural advantage of water power, there are often difficulties in its application which diminish its commercial value. Chief among these are (1) that a fall cannot always be obtained in the place where its power could be most conveniently used with regard to markets and centres of trade, and (2) the irregularity of the supply of water owing to flood and drought, which renders the power inconstant.

These drawbacks and the steady improvement of the steam engine gradually led many people to believe that water motors were inconvenient, old-fashioned, and doubtfully profitable things, and attention was more and more given to the development and improvement of heat engines to the neglect of the older water machines.

Of late years, however, various causes have combined to revive the importance of water power :—

(*a*) The frequent discussion as to a probable diminution of the coal supply in this country.

(*b*) The large working cost of the steam engine pressing upon manufacturers in keen competition and often with narrowing margins of profit.

(*c*) The rapid development of electricity for lighting and other purposes, with its demand for power at a cheaper rate, and

(*d*) Perhaps most of all, that the electrical engineer has begun to succeed in transmitting energy easily and cheaply to a distance from the source of power, and storing it for use as required.

The effect is visible in the large capital expenditure incurred in many places in impounding water under favourable conditions and distributing its energy.

Instances will occur to many members of the association, such as at the Falls of Schaffhausen, on the Rhine; Geneva, on the Rhone; Tivoli, for the supply of electric light to Rome; Holyoke, in Connecticut; the experiments at the Frankfort Exhibition; the great scheme now in course of construction for attaching and distributing power from the Falls of Niagara, and many others.

Such natural sources of power in this country are very limited in extent, though, on the other hand, opportunities for using tidal power are more numerous.

In many estuaries some useful work is now obtained from this source in transporting barges, and it may be interesting to notice that on the flood tide a vessel is, in effect, moved by flowing water up a gradient.

Work is also done by the tide in lifting vessels lying at anchor through the height of its range, though this serves no useful purpose. It is estimated that in lifting a ship of 2000 tons through a range of 20ft., the continuous effort is equal to $7\frac{1}{2}$ H.P.

The most effective method known for using tidal power, from an hydraulic point of view, is to impound the water and work turbines on the ebb.

In general, however, the great capital cost for works to impound the water, and the further outlay for secondary reservoirs at high level, or other means for securing a constant power, render commercial success in this direction so uncertain that little has yet been attempted on a large scale, although where the configuration of the land and other considerations are very favourable, schemes propounded for using tidal power in this way may, and probably will, be successful.

Some measure of the quantity of water that it is necessary to impound in order to obtain any large amount of power may be gathered from the calculation that, with a tidal range of 20ft., it would require a reservoir of one acre in extent to obtain 25H.P. for eight hours a day.

But there is another, though hydraulically less effective, method of obtaining useful work from rivers and tides in the many cases where moderate power only is required, or where the local conditions and great capital cost prohibit the construction of impounding works—namely, by using the energy of the *flow*.

In non-tidal rivers this force is, of course, continuous, and even in estuaries and tidal channels, in ordinary circumstances, it is available for about 16 hours a day on ebb and flood.

It is found that the total energy of a stream varies as the *cube* of the velocity, and that the pressure exerted against a plane surface at right angles to the direction of motion varies nearly as the *square* of the velocity or equivalent head.

Table A has been prepared from well known formulæ, and shows the pressure per square foot, the equivalent head in feet and in inches, and the total energy per square foot of sectional area for velocities from 1 to 6 miles an hour, which will be sufficient to cover the case of most currents.

TABLE A.

Velocity of Stream.		Equivalent Head.		Pressure.	Total Energy.
Miles per hr.	Ft. per. sec.	Ft. and dec.	In. and dec.	Lb. per sq. ft	H.P. per sq ft. sec. area
1	1·467	0·033	0·43	2·1	0·0055
2	2·933	0·134	1·62	8·4	0·0445
3	4·4	0·300	3·60	18·9	0·15
4	5·867	0·534	6·42	33·6	0·355
5	7·333	0·834	10·07	52·5	0·691
6	8·8	1·200	14·39	75·6	1·2

It becomes obvious from these calculations that in a stream of small sectional area and low velocity the total energy of flow at any point of section will be very small, and practically that useful work by means of current motors is only to be looked for in streams having a high velocity or large sectional area with less speed.

(*To be continued.*)

*Paper by F. Purdon and H. E. Walters, read before the British Association.

Trade Notes.

The directors of Messrs John Abbot and Co., Park Works, Gateshead, recommend a dividend of 3 per cent.

The Society of Escaut et Meuse at Anzin, France, have erected a new furnace for the production of basic steel.

Messrs. Ernest Breda and Co., of Milan, have received an order for four locomotives for the Rete Mediterranean Railway.

The John Cockerill Company, of Liege, Belgium, have received an order for 21 steel guns from the Danish Government.

The tender of the British Insulated Wire Company, for the lighting of the town of Prescot by electricity, has been accepted.

The Grusenwerk of Madgeburg-Buckau has acquired the gas engine business of Messrs. Buss, Sombart and Co., of Friedrichstadt, Madgeburg.

It is stated that the Inman and Inter national Steamship Company are in the market for two cargo vessels of about 8000 tons each.

Messrs. Vaughan and Dymond, of Newcastle-on-Tyne, have contracted to construct a steel suspension bridge over the River Conway, at Conway.

The directors of the Birmingham Small Arms and Metal Company Limited announce a dividend of 20 per cent. per annum for the past half-year.

Messrs. Drysdale and Co., Glasgow, have just completed the erection of two powerful centrifugal pumps at the Mercantile Dry Dock, Newcastle.

Messrs. Arrol and Co., Dalmarnock Ironworks, have received the contract for rebuilding Bonar Bridge, Scotland. The contract price is £12,600.

The Rhenish Steel Works, of Ruhort, Germany, have received an order for 35,650 tons of steel rails and sleepers from the Swiss North-west Railway Company.

The authorities of Villena, Spain, are inviting tenders until the 6th of September for the concession for the electric lighting of the town for a period of 50 years.

The American Steel Barge Company have instructed the Cleveland Shipbuilding Company, of Cleveland, U.S.A., to make six boilers for use on board a whaleback steamer.

Messrs. P. and W. MacLellan Limited, Clutha Works, Glasgow, have undertaken a contract to construct a steel bridge for the Indian Government 2300ft. long, in spans of 100ft.

The director of the Naval Construction Department at Spezzia is inviting tenders for the supply of the copper and brass tubes required by the Italian Navy during the year 1892-93.

Tenders are being invited by the Baden State Railways at Carlsruhe for electric-light installations on board the steamers "Kaiser Wilhelm" and "Greig," which navigate Lake Constance.

Messrs. Thos. Robinson and Son Limited, of Rochdale, have completed a large band-saw for sawing logs from 4ft. to 5ft. thick. The band pulleys are 6ft. in diameter, and the saw is 42ft. long.

Messrs. G. and J. Burns, of Glasgow, have commissioned the Fairfield Shipbuilding and Engineering Company to construct a steel screw steamer of great speed and light draught of water.

Messrs. Merryweather and Sons, London, have received an order for a double-cylinder "Greenwich" steam fire-engine, of a capacity of 450 gallons per minute, from the Local Board of Great Harwood, Lancashire.

The tender of Messrs. Peirson and Co., London, for the supply and erection of the ironwork for the Merediths Wharf Depôt of the City of London Electric Lighting Company Limited, has been accepted, the amount being £2396.

Messrs. Maudslay and Co., engineers, London, have received instructions from the Admiralty to proceed at once with the work on board the "Devastation" at Portsmouth. The firm are providing the "Monitor" with new engines and boilers to indicate 7000H.P. with modified forced draught.

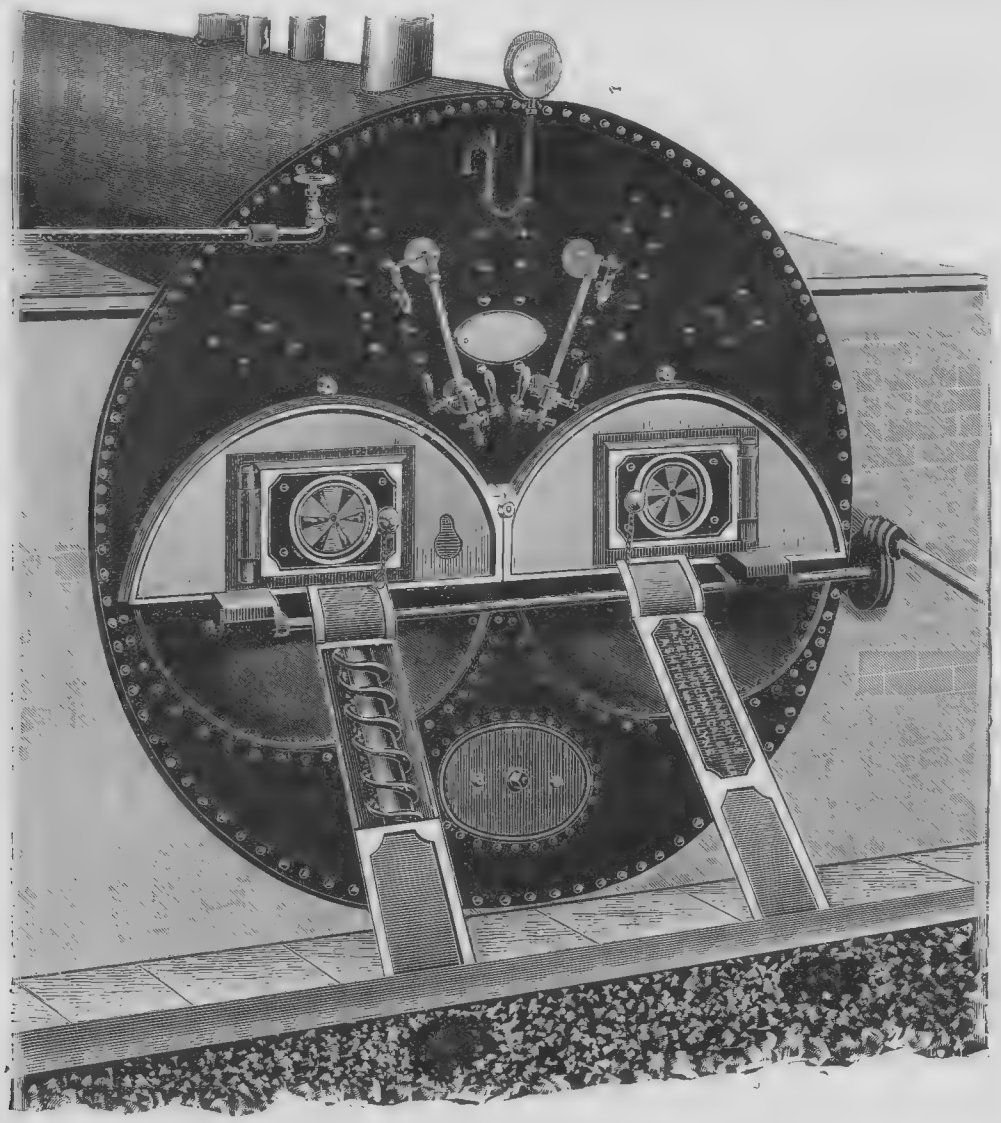
Wheel cutter in metal only. Every description of gearing. R. Chidlaw, 43, City-road, Manchester.

Having regard to the enormous circulation of The Mechanical World, the Editor suggests that it is by far the best medium for the insertion of every kind of "Wanted" advertisement, and the price is only one halfpenny per word. The Editor will be glad if Mechanical World readers will kindly bear this in mind as occasion arises.

Improved Mechanical Stoker.

WHILE there can be no question that millowners, manufacturers, and steam users generally are disposed to favour the use of mechanical furnace-feeding devices, opinion as to the best system of machine stoking is as yet largely divided. It is obvious, however, that having in view the somewhat exigent conditions under which such machinery is operated, simplicity of arrangement must, other things being equal, be held to be of the first importance.

The automatic stoker illustrated herewith has been devised by Messrs. Dyson and Williamson, of Good Hope Mill, Bentinck-street, Ashton-under-Lyne, where we had the pleasure of inspecting it in operation a few days ago. The boiler is of the Lancashire type, 28ft. long by 7ft. diameter, working at a pressure of 75lb. per square inch, and supplying steam to a compound condensing engine of 280I.H.P. The stoker is on the coking principle, the coal being conveyed to the deadplate of each furnace by means of a helical-screw conveyor about 9ft. long, working in an inclined trough as shown. The lower end of the trough



IMPROVED MECHANICAL STOKER.

communicates with the coal store, the supply of fuel entering the fire being regulated in a very simple manner. The upper end of the worm projects somewhat above the level of the deadplate, but as it is always more or less immersed in fresh coal, it is not injured by heat in any way. As the fuel is deposited upon the deadplate it becomes coked, and by the continued action of the worm it is pushed on to the bars, certain of which are given a longitudinal rocking motion, gradually conveying the fuel to the back of the fire. It is claimed that as the fresh supply of fuel is introduced below the level of the fire, ignition proceeds from the top downwards, so that but little smoke is formed, and what is generated is consumed as it passes over the glowing fire at the back of the grate. Arrangements are made by which the speed of rotation of the worms can be altered as desired, while by the aid of a removable stop each set of moving bars may be thrown out of operation. To ensure the constant and regular delivery of the coal to the conveyor troughs, a shaking attachment is provided, the speed of which can also be adjusted. We may say that at the time of our visit the emission of smoke from the fire was practically nil, notwithstanding that the boiler was being very heavily fired. No tests have yet been made as to the actual economy effected over hand firing, but since the application of this stoker the economiser has shown an increase of from 30° to 35°, a result which is unquestionably largely due to the absence of sooty deposit on the pipes.

As will be gathered from the foregoing, Messrs. Dyson and Williamson's stoker is exceedingly simple, and as there are no parts running at high speeds, or bearings to become choked or clogged with dust, it is not likely to get out of order or to require the renewal or repair of any portion. Moreover, it has the advantage of not interfering with the existing fittings on the boiler front, while, as the ordinary furnace door opening is not restricted in any way, hand firing can be resorted to at any time, and the fire attended to as required; much labour is also saved, as there are no hoppers to fill. The fuel at present used at the Good Hope Mill is small slack, but it is evident that the fire can be equally well fed with coal of a fairly large size. We think, says THE TEXTILE MANUFACTURER, it will be evident from what has been said that this mechanical stoker has much to recommend it to the notice of steam users generally, not only as a device which effects a saving in fuel and prevents smoke, but also as a labour-saving invention. The inventors will be pleased to supply further particulars upon application at the address given above, and to show the stoker in operation to persons interested.

Employment in the Engineering Trades.

THE reports issued for the past month by the trade union organisations connected with the engineering industries show no very material change, either as regards the condition of trade generally or the number of out-of-work members on the books of the respective societies. The returns of the Amalgamated Society of Engineers show a slight increase generally in the number of out-of-work members in receipt of donation benefit, but in this immediate district the number remains pretty much the same as last month, and the unemployed all through the Society continue at about 5½ per cent. of the total membership. The report of the Steam Engine Makers' Society shows, if anything, a slight improvement, but not sufficient to affect the returns of unemployed generally, which are still about 2½ per cent. of the total membership in receipt of out-of-work donation. With regard to the condition of trade, the reports from various districts show that there is a fair amount of activity in heavy stationary engine-building centres. Millwrights are also fairly employed, and locomotive builders in some districts are also slightly better off for work. Machinists generally, however, are only very indifferently employed, and the marine centres throughout the country show no improvement.

On the Metallic Structures of the Future.*

THE author discusses two matters which, in his opinion, will receive in future greater attention than hitherto in the construction of bridges—viz., the vibrations caused by the regularly-timed impact of a passing load, and the use of aluminium in an alloy with iron.

If a system of bars—for example, a Warren girder—receives in any part a single impulse creating a longitudinal vibration in a bar, such single wave is transmitted by various ways to any given distant point of the system, which therefore receives a number of impacts from various directions, either simultaneously or consecutively. If the impulse is repeated at intervals which are in simple proportion to the time occupied in reaching the given point, it may happen that at such point vibrations of increased and dangerous magnitude occur; or if the interval is modified, it may happen that the vibrations neutralise each other.

The same applies to transverse vibrations, such as are produced by the regular step of soldiers, by wheels running over the single stones of the pavement or over the joints of rails, and by imperfectly balanced driving wheels of locomotive engines.

Experiments made on a suspension bridge at Prague with Fränkel's extension gauge ("Dehnungszeichner") are given in proof of the theory. The middle span of the bridge is a continuous girder, supported at five intermediate points from straight chains. A train of ten loaded carts produced in one of the chains a strain of 1·9 ton per square inch gradually as more carts appeared on the bridge. Quite different was the effect of a troop of soldiers marching in step; the girder made violent transverse and the chain longitudinal vibrations; the quiescent strain in the chain corresponding to this load was less than 1 ton, but the vibratory strain reached 2·86 tons. At the same time no vibrating effect was noticed in the next chain.

After alluding to Professor Robinson's observations and calculations (Ohio Railway Commission, 1883), showing that bridges of a certain span are exposed to danger by passenger trains, and bridges of another span by goods trains, on account of their different speeds, the author investigates mathematically the number of vibrations pertaining to girder bridges per unit of time, of a given moment of inertia of the section, modulus of elasticity of the metal, span and weight, and shows that the results agree with those obtained by Bresse and Clebsch, and with observations made. Thus the number of vibrations in a second, of bridges of between 32·8 and 328ft. span vary between 6·1 and 1·9 when loaded, and between 15·3 and 2·6 when not loaded. On the other hand, the number of impulses caused by the balance weights of the engine wheels, easily calculated with their diameter and the speed, were found to vary for speeds of about 12 to 50 miles an hour between 1 and 5·9 per second; in the same way the number of impulses caused by the wheels striking the joints of the rails, and calculated from the speed and the wheel base, varied for the above speeds between 3·08 and 18·56 per second. A comparison of these figures with those given for the number of vibrations of bridges of various spans shows the possibility of danger arising from a certain speed. In reality the conditions are more complicated, because the two cranks attached to the same axle are at right angles to each other, the wheel bases of a train are irregular, and the number of vibrations of the bridge decrease as the train proceeds on it. The author gives directions for the investigation of any special case by a graphical method, and then refers to the fall of the bridge at Mönchenstein, near Basle.† He calculates the number of vibrations of the bridge, and finds them to be 4·68 per second when loaded, 5·82 when half loaded, and 8·82 when not loaded. The speed of the fatal train was 33ft. per second, the distance between the axles 5·9ft., and the number of impulses, therefore, 5·6; similar results are obtained with regard to the balance weights, and the author thinks that the correspondence between the impulses and the vibrating period of the bridge may have been a factor in the destruction of the bridge. At all events, he thinks that from the above theory it may follow that it is advisable to try every bridge with various trains and speeds, in order to ascertain those which are dangerous to it.

In the second part the author reviews the extensive experiments with wrought iron, Siemens steel, and basic steel, recently made at the instance of an official commission in Bohemia. The commission came to the conclusion that each of the three metals is suitable for bridge construction, and, in particular, that Siemens steel and basic steel have proved to be of equal value. Experiments at low temperatures were intended, but not made; but the author gives results obtained by himself with the three metals, and with aluminium basic steel in August, 1891. In all cases the tensile strength was increased, but the elongation and contraction diminished by cold. Relatively good qualities were shown by the new alloy, which had a breaking strain of 29·7 tons, 22 per cent. elongation in 8in., and 64·7 per cent. contraction at − 76° F., whilst 27·7 tons, 26, and 66·5 per cent. respectively, at + 43° F. It was proved that in bending slowly, or under the hammer, an injury to the surface detracted much more from the resistance at a low than at an ordinary temperature. The question, however, whether these experiments at low temperature have given useful results, appears to the author an open one.

Further experiments made at the suggestion of the author, with a view to improve the ingots in respect of their invariably porous condition near the surface and at the core, have so far given very promising results. The alloy contained quantities of aluminium, varying between 0·11 and 0·43 per cent. of weight. The effect of the aluminium was an increase of strength of the alloy, and a complete disappearance of the bubbles in the ingots. While the author is careful not to draw fixed conclusions from these limited experiments, he thinks that in future aluminium will probably play a prominent part as a

* Inst. C.E.: Foreign Abstracts.

† Minutes of Proceedings Inst. C.E., vol. cvii., p. 456.

clarifier of metals used for structures; but as it is easily affected by acid and alkaline liquids, that the expectations attached to it as a structural metal by itself will not be realised.

Hydraulic Machinery.—IX.

Hoists and Lifts.—The hydraulic hoists in general use may be divided into three classes—viz., the direct-acting, the suspended lift, and the balanced lift.

A direct-acting hoist is shown in Fig. 25, and consists of a cylinder and ram, placed vertically and acting directly on a table or wrought-iron cage carrying the load. The hoist shown is a 30cwt. luggage hoist, for connecting the subway with the platform level, and has a stroke of 16ft. The cylinder and ram are of cast iron, fixed vertically in a brick well. Where this form is inadmissible, owing to the nature of the ground, a well pipe of cast or wrought iron may be substituted for it. The cage is of wrought iron, built of plates and angle irons riveted together, and is provided with a suitable casting on the underside, for attachment to the ram. Buffing timbers are provided for the cage to rest on when down, and about 1½in. to 2in. clearance is allowed between the ram and the cylinder bottom. The guides are of angle iron, fixed to wood blocks built at intervals into the hoistway. Sliding gates are provided at the top and bottom, worked by the cage, the top gate being lifted by projecting horns fixed to the under side of the gate, and the bottom gate by chains and pulleys. The valve is of the slide-valve type, fixed direct on to the cylinder, and worked by levers and hand rods passing up through the cage. Tappets are fixed on these rods, and automatically close the valve at the top and bottom of the stroke. As an additional safeguard dead stops are fixed so as to render it impossible for the ram to be forced out of the cylinder.

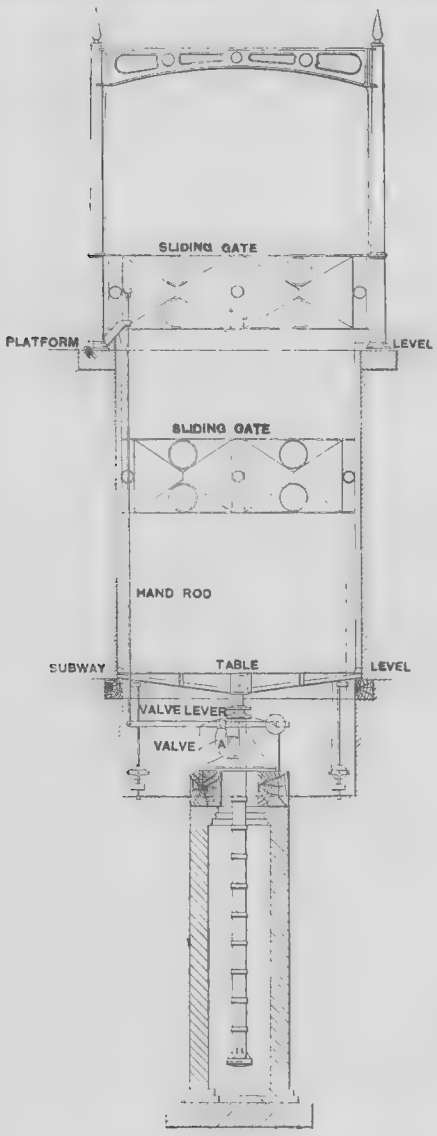


Fig. 25.

Fig. 26 shows an arrangement of suspended lift. It consists of a cylinder similar to the lifting cylinder of the hydraulic crane already described. The ram works down so as to act against the weight of the cage, and is made with a long a stroke as possible, so as to reduce the multiplying power and obtain a higher efficiency. The cage is of wrought iron, covered in, and if for passengers it is properly upholstered. It is provided with safety gear, as shown in Fig. 27, consisting of four serrated cams, which are held out of gear by safety chains attached to the sheaves in the centre of the cam shafts. These chains in pulling the cams out of gear also compress four volute springs, which, on the chain breaking, throw the cams into gear and jam the cage in the guides. Another form of safety gear suitable for the suspended cage was fully described in The Mechanical World of May 25, 1883—viz., that by M. M. Lievens, and is much used on the Continent. Chains or wire ropes are generally used and are often duplicated, each separate rope being capable of sustaining the load, so that in the event of one breaking the other takes the load. When the load is too great for one rope and two or more ropes are adopted, they should always have an equalising sheave, so as to ensure each rope taking its due proportion of the load, as without this one rope might stretch more than another, and so throw the load all on to one rope. The valve is the same as used for the direct-acting lift, and is attached direct to the cylinder, being worked by an endless rope passing through the cage or by a rope and weights, as shown. Dead stops are fixed on the guide bars, and also a self-acting tappet rod, for stopping at the top and bottom of the lift.

Hydraulic Machinery.—Fig. 26.

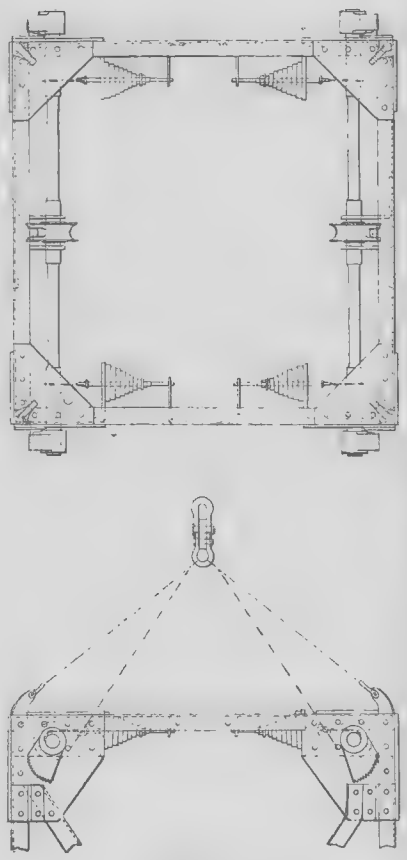


Fig. 27.

(To be continued.)

The Utilisation of Exhaust Steam.*

Within the past ten years much thought has been given to the subject matter of this paper. When steam heating as an art was in its infancy there was little or no occasion to consider it, as eight, twelve, and twenty-storey office buildings were unknown as well as unthought of. Manufacturing was usually done where water furnished the power, and public buildings were small and widely scattered. To-day we find steam supplanting water as a motive power except in a few favoured localities, and year by year larger engines take the place of smaller ones.

We have to-day many manufactories, using hundreds or thousands of horse-power, making a line of goods which were made by hand-power a quarter of a century ago. Where the power required is in the teens the question of utilising the exhaust is not very important, but in large plants it becomes a very serious matter. Many of our factories are long distances from the coal mines, hence the question of economy of fuel is constantly up for consideration.

The water used for supplying the boilers is frequently hard and impure, and in some municipalities is scarce and high in price, and becomes a considerable element of cost.

The temperature of the feed water also deserves more consideration than it usually receives, as a low temperature means high fuel bills, and frequent and expensive repairs to boilers and fixtures.

Then, again, where engines are used with large piston areas, the question of condensing or non-condensing engines must be considered.

I believe that there are few instances where it is good practice to apply a condenser to a stationary engine unless the piston area is over 1000 sq. in. I have in mind an instance where a condenser was working on an engine which furnished the power for a large factory, and the apparatus was changed over to a non-condensing for winter use, and there was no apparent loss of power, although no tests were made, but the saving of fuel for running the establishment was great, as no extra boilers were required to heat the buildings. On small piston areas the vacuum obtained is considerable.

If 24in. could be formed, which is exceptionally high, there is a doubt of its being any great factor of economy. We must consider the fact that a large amount of water must be supplied to operate the condenser. Then there is the power required to operate the air pump, and last, but not least, the low temperature of the feed-water, as it seldom runs above 140°, and frequently runs down to 120°, and even 110°, thus requiring a large amount of fuel to bring the temperature up to 212°, the point which can be readily obtained by using the exhaust for this purpose.

All of these questions are of recent date, as the art of steam heating does not claim to be an ancient one, and many of the engineers of to-day remember when it was unknown; consequently no question which arises regarding the use of exhaust steam has been settled beyond controversy, but we are in the same condition of development as many other mechanical arts—*i.e.*, in a stage of progression, and we can only report results achieved by certain processes, and never say we have covered all possibilities.

With these ideas in view we may claim many things for exhaust steam which have, until recently, and in fact by many are considered impossibilities.

Many engineers of wide experience have considered exhaust steam as valueless, and something to be well rid of as rapidly as possible; but in most of our large cities, and in many manufacturing localities, the item of fuel is one which must be carefully attended to, or the art of producing heat or power (and we are beginning to regard heat and power as synonymous terms) will exceed what some competitors pay for the same article.

While the exhaust from a 10H.P. engine may be wasted with a slight loss, the manufacturer or owner of a large building who would recklessly waste the steam from several hundred horse-power would be considered very extravagant. The question then arises, What shall we do to get the greatest benefit from the exhaust steam of any engine?

In order to determine this we must first find its value. We will not go into any elaborate calculation, but will say from experience that the exhaust steam from the average stationary engine is worth for heating purposes 85 per cent. after leaving the engine cylinder of what it was worth when it left the boiler; or, to state it differently and arrive at the same conclusion, we would put it thus:—

Steam taken from a boiler at a pressure of 60lb. to 100lb. and expanded in the cylinder of an engine to nearly an atmospheric pressure only loses about 15 per cent. of its heating power. This being the case, it would seem very improvident to throw this valuable agent away after producing it at a great cost in fuel and labour.

In order to get the greatest benefit from this heat in the form of exhaust steam, the first objective point is to thoroughly heat the feed-water for the boiler. This is accomplished in a greater or less degree by many of the heaters on the market, but usually they are rated too high.

A feed-water heater is valuable in proportion to the square feet of surface which it brings in contact with the steam, provided its construction is fairly good in other respects, but heater manufacturers, as a rule, do not publish any data by which this may be computed, and actual tests show that many of these do not heat the feed-water to above 190°, whereas a properly constructed heater should raise the temperature of the feed-water from 40° to 212°, or even above if possible.

It will repay any parties running an engine of 40H.P. or over, says Mr. E. P. Bates, in the "Stationary Engineer," to keep a thermometer on the feed-water pipe, and, if the heater then in use will not bring the temperature of the feed-water to the highest point, it should be immediately replaced by one of a much larger size and of more improved pattern.

The thermometer will also serve to notify the engineer in case the heater fills with mud or scale, thus rendering a large portion of its surface inoperative. Another point which rarely receives notice is that the feed-water pipe after leaving the heater should be carefully felted to its point of entering the boiler.

Heating the feed-water means more than saving fuel. It means prolonging the life of the boiler, and reduces the danger of explosion and loss of time from leakages and breakdowns. The feed-water should receive every degree possible before leaving the heater, and in order to accomplish this result the heater should be much larger than those usually rated for this purpose.

We would say to the heating engineer, If you wish to obtain good results in this direction, use the thermometer universally.

Exhaust steam may be used to advantage to warm the water for laundries, hotels, and all public buildings, and is a good, convenient, and economical agent for this purpose; but more surface is required to accomplish the same work if exhaust steam is used than it would if live steam were supplied directly from the boiler, but with a proper addition of heating surface the work can be equally well done by exhaust steam.

In the city of Boston a large block is partly warmed by bringing the exhaust steam from the elevator engines in contact with the hot-water circulation which warms the building, and is a very ingenious arrangement, and worthy the careful examination of the heating engineers; but the largest field for utilising exhaust steam is in warming air, or, as we commonly state it, warming rooms in various buildings immediately connected or adjacent to an engine.

The question then arises as to the best method of applying the heat.

Here doctors often disagree, but we must rely on experience where results have been obtained.

To illustrate this point I will take up a piece of work and describe it somewhat in

* A paper read before the Fourth Annual Convention of the Master Steam and Hot Water Fitters' Association of the United States.

detail, in response to repeated requests from engineers and parties interested in this subject. I will, therefore, describe the exhaust-heating apparatus placed in the buildings of the Studebaker Brothers Manufacturing Company, of South Bend, Ind., some four years since.

The buildings referred to contain about 27 acres of floor, and in consequence the area is sufficient to secure definite results. In making a preliminary survey of the premises it was found that the boilers supplying the engines were about 500 H. P., and were generating steam at about 100lb. pressure, but through improper connections the engines did not receive the full boiler pressure, the cards showing an unusual loss through friction; also showing an excessive back pressure, although the exhaust pipe went into the atmosphere a few feet above the roof of a low building, none of the exhaust steam being used for warming the buildings; but a second plant of about 500H. P. was operated during the cold season expressly for warming the buildings, carrying a pressure of about 60lb., and the full pressure being carried on the heating lines and radiating surfaces, with a vacuum pump on the returns.

The owner stated through his representatives that they were unable to properly warm the buildings and keep the drain pipes free from condensing water, and that they sometimes had a freeze-up in consequence, which was very expensive both as to quantity of material used and labour of workmen lost on account of the room being cold for several days while repairs were being made.

After the survey was completed arrangements were made to warm the buildings by exhaust steam during working hours, and supplemented by live steam being drawn from the first-named set of boilers when the engines were at rest. In fact, this set of boilers were to supply all the steam to be used about the plant, both for power and heating.

In the construction of the work certain things were considered important:—

(1.) The steam supply pipes to the engines were enlarged more than 100 per cent., the exhaust pipes were enlarged about 50 per cent., and if it had not been too complicated a piece of work, attended by great expense and delays, we should have enlarged the valve ports to the engines.

The next thing on the programme was to place a large receiving tank as near the engine cylinders as possible, to receive and store the exhaust steam. This tank should have an area relative to the area of the engine cylinder, the speed of the piston, and pressure of the steam used, a long stroke, slow-running engine requiring more storage capacity than a high-speed engine developing the same power, but the storage capacity should be sufficient to take all the impulse from the exhaust steam. To this expansion or receiving tank the exhaust steam is conveyed through as short an exhaust pipe as possible, and this tank or receiver has many offices]:—

(1.) It reduces the back pressure on the engine primarily by shortening the exhaust pipe.

(2) By forming an elastic cushion to exhaust against.

To this tank is connected a live-steam injection pipe to supply steam direct from the boiler when the engine is not in use; from this tank is taken the exhaust pipe through the roof, with back pressure valve slightly weighted, also the various distributing mains which ramify to all parts of the works.

The exhaust steam from the main engines represents the larger volume, but we also collected from the boiler feed-pumps, electric-light engine, elevator engine, and others used for small power in convenient places.

The distributing mains vary in size, being proportioned to the volume of steam required in the building which they supply. The mains are all covered with non-conducting substances. The radiators are mostly 1in. pipes, some twenty miles of this style being used in the buildings, and several miles of other sizes.

I am aware that there is considerable prejudice against the use of 1in. pipes for factory warming, but the results in this and many other pieces of work constructed on the same general principle warrant their use for the very lowest pressures. The circulations were mainly placed on the ceiling at the request of the owner, and vary at different points from 4 to 12in., and from 40 to 100ft. long. The return pipes are gathered together at accessible points, and are usually run in trenches outside the buildings and are carefully graded to the engine house, each building having a separate return to engine house, at which point they all discharge into a hot well, or return-water tank, preferably above the water line.

From the return tank there is a vapour or relief pipe connected to the bottom of the exhaust or expansion tank, which serves a double purpose, as it allows the vapour to escape from the return tank, and also removes the condensed water from the expansion tank. The feature to be desired in such a system is to produce a balanced pressure at all points of the apparatus.

(To be continued.)

Applications of Superheated Steam for Steam Engines.*

THIS paper gives an account of a series of steam-engine experiments made in 1891 with and without superheated steam, with the view of ascertaining the actual economy of fuel and steam realised by superheating. With one exception the trials were carried out upon Woolf beam engines. One object was to determine whether, by the use of superheated steam, sufficiently favourable results could be obtained from old and uneconomical steam motors to justify their retention, instead of discarding them for modern engines. Unfortunately the author and his coadjutors were only able to test two kinds of superheating apparatus. Other methods were either not reduced to practical working conditions, or, like the Schwœrer system, the experiments made upon them were not ready for publication. In this paper the results of eight sets of experiments are given, preceded by a short account of the method adopted of superheating the steam.

Gehre Superheater.—In this system, as at present used, the steam is not heated by a separate apparatus, but the superheating pipes are placed in the flues of the boiler. This method of superheating the steam has been extensively adopted. It is simple, requires no separate stoker, and can be easily introduced into existing flues. One apparatus is often used to heat the steam from two boilers. Where the boilers are at a distance from the engines and long steam pipes are required, the Gehre system has been found insufficient. The inventor is now endeavouring to remedy these defects, and to adapt his method to other working conditions.

A series of experiments extending over six days were carried out with the Gehre superheater. The economy obtained by the use of superheated steam was calculated in quantities of coal pure and dry (deducting moisture, ash, and clinker), and care was taken to make all the trials under ordinary working conditions. Four boilers were in use, and a Green feed-water heater. There were three sets of superheaters, and the hot gases passed once only under the boiler, and then through the flues on their way to the economiser. The steam was used by a couple of Woolf beam engines with variable expansion, and was superheated 100° F. The trials were in pairs on two successive days with and without superheating, and each trial lasted about ten hours and a half. The mean pressure of steam was 5·5 atmospheres. In the original paper tables of results of the experiments are given in full detail, both for the boilers and the engines. The economy due to the use of superheated steam was 11·2 per cent. of steam per hour per I.H.P., and 8·7 per cent. of coal pure and dry per I.H.P. per hour. The gain per cent. was less than might have been expected, and lower than in the later trials. The defective utilisation of the heat is attributed by the author to the insufficient surface of the superheater, which was too small for the size of the boilers. The same engine had been tested a few years previously with ordinary steam. With five boilers instead of four in use, practically the same results for H.P. and consumption of coal were obtained, showing that with superheating four boilers would do the work, whereas five were required with ordinary steam.

Uhler Superheater.—This is the first of his new appliances at work in or near Mulhausen for superheating the steam with a separate fire. It resembles a Field boiler. The ordinary steam passes from the boilers into a series of small vertical pipes, set inside larger tubes, and heated directly from a separate furnace. The steam is thus dried and superheated as it rises through a number of these tubes into a collector, and from thence it is led in well-covered pipes to the steam engines. This method of superheating was not found entirely successful at first, but improvements have been made, and it has now but one main defect—namely, the sedimentary deposit is sometimes formed at the bottom of the large tubes. Superheating being principally applied to high-pressure boilers, the steam contains and carries along with it a certain quantity of water, and it is liable to deposit the impurities in this water at the lower end of the tubes over the fire. If pure water be used, the tubes are kept clean, and there is no danger of their becoming clogged. The distance from the fire to the bottom of the tube is 8ft.

Four experiments on successive days, March 3, 4, 5, and 6, were made on the Uhler superheater. The economy obtained by superheating is given in steam per I.H.P. per hour. Three boilers were used with a Green feed-water heater. The superheated steam passed directly, without entering the jackets, to the valve chests of two Woolf beam engines, both of the same dimensions. On the first two days experiments were made with superheated steam, and on the last two days with ordinary steam. The mean pressure of the steam was 5 atmospheres, and it was superheated 133° F. The experiments lasted about ten hours and a half, or one working day. The economy in steam due to superheating was found to be 22·4 per cent., and the number of revolutions and the I.H.P. were also greater than when working with ordinary steam. The loss by radiation was small in these trials.

In the next two experiments, made in March, 1891, with and without superheated steam, the economy realised by the application of superheating was 30 per cent. in consumption of steam, and 27 per cent. in coal pure and dry. The steam was superheated 120° F., and the mean pressure was 4·7 atmospheres. The engines tested were about 30 years old, and were shortly to be replaced by new. The next two experiments, made under the same conditions, showed a slight leakage in the feed-water pipe, which affected the accuracy of the results, although the trials gave a coal economy, due to superheating, of 22 per cent.

During April and May four experiments were made on the same engines as before. Each trial consisted of an experiment one day without, and the next day with, superheated steam. In all the superheating tests the steam passed directly to the valve chests without entering the cylinder jackets, and the work was done with one boiler less than with ordinary steam. The experiments in April gave 19·32 per cent. economy of steam, and 25·6 per cent. economy in coal due to superheating the steam 135° F., and the pressure of the steam was 5·2 atmospheres. In the May experiments two boilers were used instead of three with ordinary steam. With steam at a pressure of 7·3 atmospheres, and superheated 93° F., the steam economy was 23 per cent., and coal economy 23·4 per cent. The superheater was some distance from the boilers, and this diminished the temperature of the steam, although the pipes were fairly well covered. Experiments carried out on the 25th and 26th June did not yield such favourable results. The economy obtained by the use of steam at a pressure of 6·4 atmospheres, and superheated 115°, was 20·6 per cent. of steam, and 17·8 per cent. of coal; but the power was unequally divided between the two cylinders, and other working conditions were not as favourable as before.

The last series of experiments were made on two successive days in August, 1891, under the same conditions, on a Woolf beam engine. The superheater was nearer the engine and boiler than on any previous occasion. Three boilers were used when the steam was superheated, but with ordinary steam four were found necessary to develop the power. The results were more favourable than in the previous experiments. An economy of 27·2 per cent. of steam superheated 113° was realised, and 25 per cent. in coal. The steam pressure was 5 atmospheres.

From the complete details of all the tests given in the original paper, of which the above figures are only a very brief summary, the author draws the following conclusions:—Taking the mean of the seven experiments made with the Uhler superheater, the increase in the boiler efficiency was 5·2 per cent. and the quantity of coal burnt per hour per unit of heating surface was diminished 11 per cent. with superheated steam. With this steam 20·7 per cent. less in quantity was produced per hour per unit of heating surface for same work done with the same number of boilers as under ordinary conditions. By the use of superheated steam, therefore, one boiler in four can be dispensed with; the fuel was also better utilised and the boilers kept in better condition, because a smaller quantity of coal was burnt and less steam evaporated per hour per unit of heating surface. It was found, and this is an important practical result of these interesting tests, that no surface damage or scoring is caused to the valves, pistons, or cylinders of the engines by the use of superheated steam, if metallic packings are employed for the stuffing boxes and the cylinders lubricated with oil of the best quality. The effect of steam jackets was diminished and was even found detrimental. In all the engines experimented upon steam was used in the jackets only to heat the cylinders before starting, and shut off as soon as the engines were running. These experiments also prove that the less difference between the temperature of the cylinder walls and of the entering steam the less condensation there will be during admission, and the smaller the gain by superheating. The tests do not throw much light on the question of steam-pipe loss. In some trials the loss by radiation was about 1° F. per 3¼ft., and in others much more; but it is absolutely necessary in all cases to protect the pipes with the utmost care, and the superheater should also be carefully covered to prevent radiation.

The author concludes by stating, as his opinion, that the use of superheated steam, as exemplified in practice for the last year or two in Alsace, gives practically satisfactory results, and can be safely recommended. A considerable economy may always be realised, but the extent of saving will depend on the construction of the engines and the rate at which the boilers are worked.

*Inst. C.E.: Foreign Abstracts.

Whitworth Scholarships, Exhibitions, etc.

THE following is the list of successful candidates in the competition for the Whitworth Scholarships and Exhibitions, 1892, issued by the Department of Science and Art:—

SCHOLARSHIPS (tenable for three years).—Herbert A. Clark (24), fitter, Crewe, £125 a year.

EXHIBITIONS (£50 a year, tenable for one year).—Charles R. Darling (21), engineer, Crewe; Frederick K. Preston (21), mechanical engineer, Grantham; Samuel Stansfield (19), engineer student, Walsden, Todmorden; James E. Lee (23), engineer, Sandbach, Cheshire; Charles E. Larard (24), mechanical engineer, Hull; William A. Tayler (19), apprentice fitter, Crewe; John S. Williams (20), engineer's assistant, Manchester; Percy W. Barnes (22), fitter, Manchester; Arthur D. Musson (24), draughtsman, Grantham; Albert Hall (21), engineer, Blackburn; John H. Grindley (18), turner and fitter, Oldham; and Francis L. Wait (22), fitter, Crewe.

In the list of successful candidates for Royal Exhibitions, National Scholarships, and Free Studentships, 1892, the following names appear:—

NATIONAL SCHOLARSHIPS FOR MECHANICS.—Cecil Baxter (20), student, Bradford; Harold R. Cullen (18), engineer apprentice, Manchester; and Walter Henson (23), mechanical draughtsman, Grantham.

NATIONAL SCHOLARSHIPS FOR CHEMISTRY AND PHYSICS.—William Longshaw (18), student, Liverpool, and Arthur Nicholls (16), student, Manchester.

NATIONAL SCHOLARSHIPS.—Harry R. Prescott (17), student, Bradford; William H. Rudd (15), student, Salford; Arthur E. Malpas (21), engineer, Manchester; Geo. T. Rison (17), student, Manchester; and Frederick K. Preston (21), mechanical engineer, Grantham.

FREE STUDENTSHIP.—Wm. H. Petty (26), student, Leicester.

ROYAL EXHIBITIONS.—John J. Green (27), student, Burnley; Martin H. A. Carroll (17), student, Salford; Robert W. Forsyth (15), student, Gateshead; and George D. Dunkerly (17), student, Manchester.

Metal Trade Memoranda.

After a stoppage of several months two mills have been started in the new part of the Abercarne Tinplate Works.

The largest aluminium works in the world are in Switzerland. They produce about 1200lb. of metal daily.

The British Iron Trade Association have just issued a statement showing the production of pig-iron in the United Kingdom in the first half of 1892, compared with the corresponding period of 1891. The production for the first six months of this year is given as 2,790,918 tons, as against 3,712,387 tons for the same portion of last year, or a decrease of 921,469 tons.

A new tinplate plant has been successfully started at the works of the American Stamping Company at Brooklyn, New York. It is equipped with the latest and most improved machinery, and is estimated to turn out about 1200 boxes per week of tinplates. The whole of this output will be used by the proprietors, who are large consumers of plates for stamping purposes,

The Lackenby Ironworks, near Middlesbrough—consisting of three blast furnaces, all in operation,—are to be sold by auction next month.

Messrs. Basse and Selve, of Westphalia, have invented a process of separating cobalt from nickel when the two occur alone. To the boiling hydrochloride or sulphuric acid solution of the oxides solution a mixture of hypochlorite and carbonate of soda is added little by little until all the cobalt is precipitated. This precipitate, CO_2O_3, is digested with dilute hydrochloric or sulphuric acid to remove any traces of nickel which may have been thrown down.

The Russian Government is endeavouring to stimulate the home industries of iron and steel, not only by protective tariffs, but also by more effective measures. Some time ago it was reported that an order had been issued to the Russian War Marine to use only Russian coal, and now the Government intends to institute a head bureau for the iron and steel masters in St. Petersburg. The bureau will consist of deputies from all the manufacturing districts, and will deal with questions regarding the improvement of the trade and other vital points.

Further important extensions of the Staffordshire steel trade are in progress, and when completed the Midland districts will be practically independent of importations from Sheffield, Scotland, and the North of England, which now supply three-fourths of the local requirements. In addition to the new mill which has just been laid down by the Staffordshire Steel and Ingot Company, and the new steelworks of the Round Oak Iron and Steel Company, which are being steadily pushed forward, the Patent Shaft and Axletree Company at Wednesbury are putting down an immense mill for rolling Siemens soft steel plates up to 7ft. and 8ft. wide. When the new mill is in operation the Patent Shaft Company will be able to manufacture all their own steel.

The Metal Market.

PRICES CURRENT.

LONDON, Aug. 22.

COPPER opened steady at 1s. 3d. advance, but, with a limited inquiry, the improvement was afterwards lost; and although buyers operated more freely in the afternoon, warrants were not difficult to obtain, and the close was quiet, with cash unchanged, but three months were 1s. 3d. lower after the official close. Cash was placed at £44 5s. to £44 3s. 9d., and three months at £44 13s. 9d. to £44 12s. 6d. Sales, 300 tons. Settlement price, £44 2s. 6d.; English tough, £47 5s.; best selected, £48 10s.; strong sheets, £56.

TIN opened firm and 5s. better, and under light offerings and covering operations, combined with some speculative interest, values steadily hardened, and after the official close there were buyers of cash and three months at an advance of 12s. 6d. on Friday's official currencies. Three months made £93 10s. to £93 15s. and early September prompts £93 10s. to £94. Sales, 50 tons. Settlement price, £93 15s. Australian was in request and gained 15s., sellers holding off. English ingots, £96 10s.

PIG IRON was firm throughout, with a good demand and little offering. Scotch advanced, 1500 tons cash changing hands at 42s. 2d. to 42s. 3d., and final rates are 3d. up for Scotch and 6d. for hematite, while Middlesbrough, which was wanted and scarce, finished 9d. higher. Settlement prices:—Scotch, 42s. 3d.; Middlesbrough, 40s. 3d.; hematite, 50s. 6d.

TINPLATES quiet. I.C. cokes, f.o.b. London, 13s.; Liverpool, 12s. 6d.; Swansea, 12s. 3d.

LEAD is steady and unchanged. Spanish, £10 6s. 3d., sellers; English, £10 10s. to £10 12s. 6d.

SPELTER remains flat. August shipment, £21, sellers. Silesian specials, ex ship, £22.

ZINC.—Silesian sheets have a lifeless market, and ordinary, in 5cwt. casks, are 2s. 6d. lower at £23 10s., ex ship. Belgian easy. V.M. brands, ex ship, £21; f.o.b. Antwerp, £23 15s.

OFFICIAL CLOSING QUOTATIONS.

	£	s.	d.	£	s.	d.
COPPER—						
G. M. B.—Cash	44	3	9	44	11	3
,, Three months	44	13	9	45	1	3
English tough	—	—	—			
Best selected	—	—	—			
Strong sheets	—	—	—			
TIN—						
Fine foreign—Cash	93	15	0	94	5	0
,, ,, Three months	93	15	0	94	5	0
Australian—Cash	94	15	0	95	5	0
PIG IRON—					s.	d.
Scotch warrants - Cash					42	3
,, One month					42	5½
Middlesbrough—Cash					40	3
,, One month					—	
Hematite—Cash					50	0
,, One month					—	

GLASGOW, August 22.—The pig-iron market was very firm, and fully 15,000 tons of Scotch were dealt in, the closing price showing an advance of 3d. from Friday. The firmness was in sympathy with the strength of the market at Middlesbrough, and also on account of makers here getting off freely all their make. Some makers have advanced their prices 6d., and Carnbrae as much as 1s. a ton. One lot of Cleveland was snapped up at 39s. 9d., with buyers afterwards quoting 6d. more. Hematite was neglected, but quoted 6d. up. The shipments last week were 6075 tons, against in same week last year 7724 tons, thus showing a decrease of 1649 tons.

QUOTATIONS.

	Highest.		Lowest.	
	s.	d.	s.	d.
Scotch warrants—Cash	42	3½	42	1½
,, One month	42	5½	42	5
Middlesbrough—Cash	40	3	39	9
,, One month	40	6	40	6
Hematite—Cash	50	6	49	6
,, One month	—		—	

Trade Marks.

The following is the Official List of Applications published from August 10 to August 17, for the Registration of Trade Marks, so far as relates to the Metal Trades.

CLASS 5.

CROMIL.

163,821. All descriptions of unwrought and partly wrought metals used in manufactures, but excluding all descriptions of iron and steel. The firm of CROSIER, MILLS AND CO, 9, Queen-street, Newcastle-on-Tyne, Northumberland; and Bonner's Field, Sunderland, Durham; merchants.—28th March, 1892.

Official Gazette.

Partnerships Dissolved.

C. VICKERS and J. VICKERS, under the style of G. Vickers Sons, Burstall, manufacturers of all kinds of chains and general mill furnishers.

W. BRENTON and T. W. WESTON, under the style of W. Brenton and Co., Polbathick and Plymouth, agricultural engineers and millwrights, iron and brassfounders and ironmongers.

B. RATCLIFF, C. W. RATCLIFF, and F. RATCLIFF, under the style of J. Ratcliffe and Sons, Wortley, Leeds, ironfounders and machine makers; as far as regards B. Ratcliffe.

P. H. GOLDSMITH and G. W. HUGHES, under the style of the Stanate Metal Company, St. Helens, as far as regards G. W. Hughes.

GRAHAM and SPERRYN, Aston Tube Works, Birmingham; as far as regards J. N. Sperryn.

H. J. COWARD and W. H. TAGART, under the style of the Bath and West of England Briquette and Steam Fuel Company, Twerton-on-Avon, briquette and patent fuel makers; as far as regards H. J. Coward.

THE BANKRUPTCY ACTS, 1883 AND 1890.

Receiving Orders.

FREDERICK WILLIAM FEARNHEAD, Caledonian-road, London, N., gas and water engineer.

ROBERT BISSET SCRYMGEOUR, St. Helens, iron and hardware merchant.

THOMAS GOAD, Orton, Westmorland, blacksmith.

Adjudications.

WILLIAM LORD, Stanningfield, late Bury St. Edmunds, late machinist.

THOMAS GOAD, Orton, Westmorland, blacksmith.

New Companies.

LOTHAMMER'S NEW GAS CO. LIMITED.—This company was registered on the 11th inst., with a capital of £10,000, in £1 shares, to acquire certain letters patent and patent rights for and in respect of an invention by Mr. F. J. Lothammer of an improved portable apparatus for the manufacture of gas; to enter into an agreement with Messrs. E. Batiste and A. Rousselle, and to manufacture, sell, and deal in gas generators, gas and other engines, and apparatus for the production and utilisation of light, heat, and power. Registered by Messrs. Nokes and Stammers, 57, Basinghall-street, E.C.

"PERSIL" FLEXIBLE WHEEL TYRE SYNDICATE LIMITED.—This company was registered on the 12th inst., with a capital of £170,000, in £1 shares, to acquire the patent rights in all countries of an invention known as the "Persil" wheel; to adopt and carry into effect an agreement to be made between Messrs. Eugene Persil and S. Brinsley Sheridan of the one part, and the company of the other part, and to carry on the business of engineers, merchants, bankers, commission agents, warehousemen, indiarubber merchants and manufacturers, metal merchants, brokers, shippers, manufacturers of and dealers in bicycles, tricycles, and velocipedes of every description, and manufacturers of and dealers in every kind of wheel and particularly the flexible wheel, and in every kind of spring and tyre. Registered by Messrs. Dix and Warlow, 4, Dane's Inn, Strand, W.C.

WATTS AND OLDHAM LIMITED.—This company was registered on the 12th inst., with a capital of £10,000, in £1 shares, to acquire, take over as a going concern, and carry on the business of general, mechanical, hot-water, gas, and electrical engineers, iron and brass founders, ironmongers, boiler makers, etc., carried on by Messrs. J. Watts and J. Oldham, at Bristol and elsewhere, and with a view thereto to enter into the following agreements—(1) Dated June 29, 1892, between Mr. J. Oldham of the one part, and Mr. W. Cambourne (for the company) of the other part; (2) dated June 29, 1892, between Messrs. J. Watts and T. W. Jacques of the one part, and Mr. W. G. Cambourne (for the company) of the other part; and (3) dated June 14, 1892, between Lord Deramore of the one part, and Mr. W. G. Cambourne (for the company) of the other part. Registered by Messrs. Drake, Driver and Lever Limited, 13, New Bridge-street, E.C.

COLLIER-MARR TELEPHONE AND ELECTRICAL MANUFACTURING COMPANY LIMITED.—This company was registered on the 10th inst., with a capital of £100,000, in £10 shares, to acquire and take over as a going concern the business of the Collier Audible Telephone Syndicate Limited; with a view thereto to adopt the agreement referred to in clause 3 of the articles (dated March 17, 1892, between the said syndicate of the one part, and Mr. E. Hampson, for the company, of the other part, as modified by an agreement between the same parties and dated August 5, 1892); and to carry on the business of manufacturers of and dealers in telephones, cable wires, lines, accumulators, engines, etc., or any other apparatus of things connected with the establishment, working, or maintenance of telephonic communication or in connection with the generation, distribution, supply, accumulation, or employment of electricity. Registered by Messrs. Nicholson, Graham and Graham, 24, Coleman-street, E.C.

Letters to the Editor.

*** *We do not hold ourselves responsible for opinions expressed by correspondents.*

*** *The name and address of the writer (not necessarily for publication) must in all cases accompany letters intended for insertion, or containing queries.*

*** *Letters intended for publication in the current week's issue must reach our Manchester Office not later than by the first post on the Tuesday preceding the date of publication.*

STAYING TELEGRAPH POSTS.

To the Editor of THE MECHANICAL WORLD.

SIR,—For several weeks past I have noticed amongst your queries column a question on the staying of telegraph posts, and as the same seems to have had no solution by your readers up to the present time, will you permit me to ask that the following may be inserted in your valuable paper, so as to show my idea of solving the above-named problem:—

First of all, I should like to point out that the dimensions as given in the sketch $n\,x\,b$ in all your issues are not correct—viz., $n\,x = 18$ft., and $x\,b = 14$ft. as given. If we take, say, the 18ft. as correct for $n\,x$, then it follows that $x\,b$ will be approximately 15ft. 4in., etc. So that by taking $n\,x$ to be equal to 18ft. 4in., which is approximately $\frac{2}{3}$rds the height of the post $c\,d$, we shall find the problem to work out easier.

Referring to Fig. 1, let $a\,b\,m$ represent the first method of staying, and let bR represent to scale a force of 100lb., in this case $b\text{R} = m\,a$; then by completing the parallelogram of forces, $m\,b$ represents the tension in the stay, and $a\,b$ the compression in the post, which are respectively 250lb. and 229lb. full.

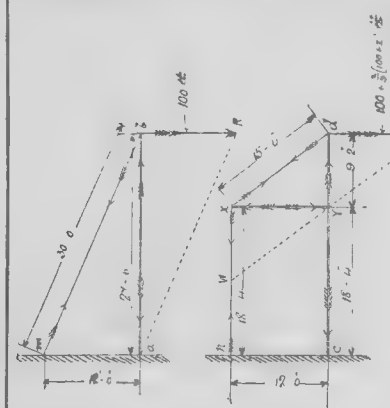


FIG. 1. FIG. 2.

But in Fig. 2 the forces are more complicated, there being tension in $n\,x$ and $x\,d$, and compression in x Y and $c\,d$, and whatever the compression may be in xY it will act upon the post $c\,d$ as if it were a beam supported at both ends and loaded at Y, with a concentrated load as in Fig. 3.

Now if a force of 100lb. be acting at d, and that the strut xY be taken out and the end x otherwise rigidly connected to something, as in Fig. 4, then by drawing the parallelogram of forces again we find that there would be a reaction at V, at right angles to the post St, equal in magnitude to the force at t, which is 100lb.; but when the strut is replaced this reaction or force of 100lb. will act through the strut and upon the beam at Y, and must necessarily form two more forces, one at c and one at d. The force at c will be in the same direction as the force $d\text{R}^1$, thereby making the total force at d more than

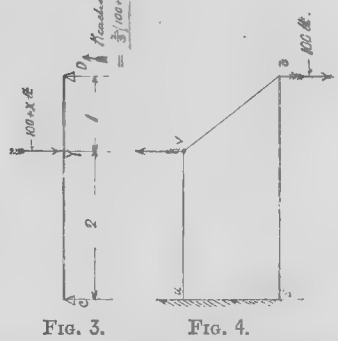


FIG. 3. FIG. 4.

100lb.; consequently this will also be transmitted through $x\,d$ and again to the strut, thus increasing its compressive stress. This will go on until equilibrium is attained; and calling the extra force in xY, so formed, x, the total compression in it will be $100 + x$. Taking this then as the concentrated load at Y, as in Fig. 3, we shall obtain an action and a reaction at d due to it alone = to $\frac{2}{3}(100 + x)$; but as the action will be in the same direction as the original force of 100lb., the total force in this direction will be $100 + \frac{2}{3}(100 + x)$, as previously intimated.

Now whatever may be the magnitude of the total forces at d, so long as the post is in equilibrium the strut xY will have the same, because by the principle of the parallelogram of forces, if $d\text{R}^1$ represents the total force to scale $= 100 + \frac{2}{3}(100 + x)$, then the lines xY, and $x\,d$, and Yd will represent the magnitude of the forces in their respective parts, the working being shown in full in Fig. 2. From this we get $x\text{Y} = d\text{R}^1$, but $x\text{Y} = 100 + x$.

$\therefore 100 + x = 100 + \frac{2}{3}(100 + x)$, from which we get $x = 200$lb.

Therefore the compression in xY = 300lb.
,, ,, ,, Yd = 229lb.
,, ,, tension ,, $x\,d$ = 375lb.
,, ,, ,, ,, Nx = 229lb.

Comparing these with Fig. 1, we find that the stay $m\,b$ withstands 250lb., while $x\,d$ in Fig. 2 withstands 375lb. Therefore we infer that Fig. 1 is the strongest method of staying under the given conditions.

The bending moment at Y equals:—
B M $= \frac{2}{3}(100 + x) \times 9{\cdot}16$ft. $= 200 \times 9{\cdot}16 = 1832$ft.-lb.

I am sorry the foregoing has taken up so much of your valuable paper, but I hope that same will prove of practical use. Thanking you in anticipation.—Yours, etc., DRAUGHTSMAN.

Heywood, August 16.

Prize Competition.

WE OFFER FOUR GUINEAS MONTHLY IN PRIZES FOR THE BEST ORIGINAL ARTICLES SENT IN ON ANY MECHANICAL, ENGINEERING OR ELECTRICAL SUBJECT.

IN ORDER THAT MANAGERS, DRAUGHTSMEN, FOREMEN, AND WORKMEN WHO HAVE HAD NO PRACTICE IN WRITING MAY NOT HESITATE TO SEND IN COMPETITIONS, IT IS TO BE UNDERSTOOD THAT ALL ARTICLES WILL BE FULLY EDITED AND CORRECTED, AND JUDGED OF SOLELY ON THEIR MERITS AS ORIGINAL CONTRIBUTIONS FROM A PRACTICAL POINT OF VIEW. THE OBJECT OF THE COMPETITION IS TO INDUCE PRACTICAL MEN TO COME FORWARD AND GIVE THE RESULTS OF THEIR EXPERIENCE.

CONDITIONS.

Competitions for our Monthly Prizes must be sent so as to arrive at the Manchester Offices of THE MECHANICAL WORLD, New Bridge-street, not later than the last Tuesday in each month. Articles arriving after that time will be placed in the following month's competition.

Written competitions must be on one side of the paper only. The contributions must be original, and relate to matters connected with Engineering, Mechanism or Electricity.

The Proprietors of THE MECHANICAL WORLD reserve the right to publish any competition, whether it gains a prize or not.

The competitions may be accompanied by diagrams, sketches or drawings.

Competitors should write the words "Prize Competition" on the envelopes.

Competitors are not confined to one, but may send any number of competitions.

The correct name and address of the sender must be distinctly written upon every competition, not necessarily for publication. Competitions can appear under a *nom de plume*.

☞ We cannot undertake to be responsible for any MSS. sent to us, though when stamps are enclosed for the purpose we will endeavour to return rejected contributions.

Miscellaneous Items.

It is proposed to construct a railway to the summit of Ben Nevis. Like the Righi Railway in Switzerland, the cog-wheel system will be used.

The contractors are now busily engaged landing material for the new lighthouse and lightkeepers' houses to be erected on Helliar Holm, in String Sound, at the entrance to Kirkwall Bay.

The Otterspool Estate, which is situated on the banks of the Mersey near Liverpool, has been bought by the Cheshire Lines Committee for £60,000, the object being to construct a dock.

The new railway up the Brienzer Rothhorn, Switzerland—the highest in the world—is proving a great success. Since its opening an average of about 300 passengers a day have climbed the mountain by it.

Mr. Robert Forster, chairman of the Scarborough and Whitby Railway Company, died at Scarborough on the 19th inst. Mr. Forster, who was formerly alderman and mayor of Scarborough, was in his 72nd year.

The Workmen employed by Mr. William Allan, at the Scotia Engine Works, Sunderland, have presented an illuminated address to him for the part he has taken in the successful establishment of the eight-hours day.

The number of broad-gauge engines on the Great Western Railway at the close of 1891 was 196. Of these 69 have since been replaced by narrow-gauge engines, 34 have been converted from broad-gauge to narrow-gauge, and 93 still remain for conversion.

A great 8ft. water tunnel, extending four miles out under Lake Michigan, at a depth of 80ft., has been completed. It was commenced over four years ago, and has cost about £220,000. When connected with the waterworks pumps it will supply 130,000,000 gallons of water per day to Chicago, bringing the total available supply up to 300,000,000 gallons daily.

An examination of the mineral products of Mergui, Burmah, is stated to show that coalfields capable of yielding 1,000,000 tons lie within a few miles of the coast.

Mr. C. E. Spagnoletti, known as the "Father of Railway Telegraphy" and the inventor of numerous electrical appliances for working the block system on many home and foreign railways, has just resigned the appointment which he has held for over 35 years as chief electric and telegraph engineer of the Great Western Railway Company. The directors have, however, retained his services for consultative purposes.

As a result of a conference between the London and South-Western Railway Company, as purchasers of Southampton Docks, and the Southampton Corporation and Harbour Board, it has been agreed that if the Inman Line of steamers makes its headquarters at Southampton for ten years, the railway company will construct a new dock and sea wall at an estimated cost of a quarter of a million. The Corporation will give them for a nominal consideration 20 acres of land, and the Harbour Board will dredge the channel to the depth of 30ft., so that the largest mail vessels can reach the docks at all states of the tide.

A remarkable undertaking has just been completed at Frodsham Station, Cheshire. Complaints have been made for years of the inadequate platform accommodation, and finally it was decided to remove the stationmaster's house, booking offices, and general waiting-room about 6ft. back. In order to accomplish the task without taking down the structures, excavations were made beneath them until they were supported on large baulks of timber. Then came the crucial point whether they would slide into their new situation. Eleven powerful jacks were brought into operation, under the superintendence of Mr. Johnson, the company's engineer. Although the mass to be moved weighed quite 400 tons, the work was accomplished without hitch, save that a chimney stack which cracked had to be taken down. This is stated to be the first occasion on which an English railway station has been successfully lifted on the American principle.

The publisher of "The Mechanical World" will send a prepaid parcel of specimen copies to anyone, in any part of the world, who can distribute them advantageously amongst his engineering friends. Business card or bill-head should be enclosed as a guarantee of good faith, and number of copies stated.—Address: 391, Strand, London, or New Bridge-street, Strangeways, Manchester.

Queries.

☞ Readers are invited to avail themselves of this section for practical information on questions relating to Mechanical Engineering and the Scientific Industries.

☞ Queries and Replies should arrive at the Manchester Office not later than by the first post on the Tuesday preceding the date of publication.

MAKERS OF CELLULOID.—Required the names and addresses of extensive makers of celluloid.—B. P.

TINPLATE MILL ROLLS.—Can any reader give the proper mixture for brasses for the bearings of these rolls?—TINPLATE.

EXPANDING RIMERS.—Will "W. A. S. C." kindly give further information *re* expanding rimers as promised, if possible?—J. W. C.

NICKEL.—In an alloy of cast iron and nickel what is the increase in strength over cast iron, and what proportion of nickel should be used?—T. C.

ECONOMISER SCRAPERS.—What means must I adopt to renew some broken scrapers in the middle of the range of pipes in the economisers?—PUZZLED.

PATTERNMAKER'S TOOL BOX.—Will any reader give me a sketch of the patternmaker's tool box, with full dimensions and particulars?—APPRENTICE.

MAKERS OF COMPRESSED PAPER.—Will any reader inform me of the address of a maker of compressed paper, such as is used for carriage wheels and the like?—T. D.

RIFLING MACHINE.—I should be glad of a sketch of any appliance used for rifling out small barrels, such as revolvers, etc., say ¼in. to ⅜in. bore, with threads, say, 6in. pitch.—NEMO.

WOVEN BELTING.—Can anyone give me the recipe for or supply me with the proper paint for cotton belting? I can weave it right enough, but cannot get a satisfactory paint.—BARCELONA.

HARDENING CIRCULAR SAWS.—Can anyone tell me how to harden a circular saw 20in. diameter and ⅛in. thick, to saw cast iron? I want to harden the cutting part only, and not the body of the saw.—J. WILSON.

JAMES' PATENT SOUNDING MACHINE OR SUBMARINE SENTRY.—Can any reader oblige with particulars of this apparatus, or name of makers?—J. P.

HOT-AIR ENGINE.—Will some reader of THE MECHANICAL WORLD kindly oblige me with a section and principal dimensions of a ½H.P. single-acting hot-air engine of the Stirling cycle?—GEO. H. PERKINS, North Queensland.

ROLLER-BORING TACKLE.—Will some reader favour me with a sketch of a tool for boring hard wood rollers of various kinds in the lathe from 1ft. to 3ft. in diameter, and from 3ft. to 5ft. long? The holes are to pass right through, and to be from 1in. to 3in. diameter.—BORE.

VOSPER'S ENGINE.—I have a Vosper's patent high-speed four-cylinder engine, and should be glad to know what the cut-off in each cylinder should be; also the position of eccentric sheave at any given point? I believe the eccentric sheave has been altered before the engine came into my hands. A sketch would oblige.—R. F.

MAKERS OF STAMPED FORGINGS.—Required the names and addresses of firms making drop stamped joints and pins in small quantities.—J. T.

LOSSES IN STEEL FURNACES.—Could any reader kindly inform me the average per cent. of actual loss, and the average per cent. of skull, in the charge of a Siemens open-hearth steel furnace working charges of from 30 to 40 tons? And also the per cent. of loss in heating slabs and ingots in the Siemens regenerative gas furnace?—J. R. R.

BOAT PROPULSION.—If a boat floats down a river, will it be carried forward at the same speed as the stream is flowing? Or can it be proved that it will go slower than the stream? How much force in lb. will be required to propel a boat of a given weight against a stream or up a river flowing with a certain velocity, so that the boat shall move up the river with the same speed that the stream is flowing down?—HYDRA.

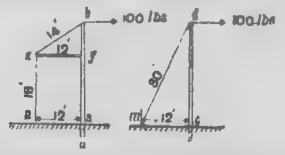
WATER FLOWING INTO JET CONDENSER.—Will some fellow-reader kindly give me a worked-out example of the quantity of water that will flow through a 4in. pipe 30ft. long, with four bends, into a jet condenser with 18in., 24in., and 28in. of vacuum; wheel valve wide open, giving same area as pipe; also with it half open? The water supply tank is 8ft. below condenser. The condenser is working on a set of triple-expansion engines. What effect have bends and temperature on supply water?—SUGAR MILL, North Queensland.

LOCOMOTIVE CONSTRUCTION.—Will any correspondent enlighten me as to the mode adopted in locomotive work in order to fix the position of the axles (horizontally) so that each axle may have a predetermined portion of the total weight resting upon it? Say:—

Load on leading axle	0·32
„ driving „	0·48
„ trailing „	0·20
	1·00

Of course, I am aware there are certain circumstances—such as length of barrel, position of firebox, etc.—which in practice to a great extent influence this; but the point I wish clearing up is: Given the total weight, how are the positions of axles determined so that the pre-arranged weights rest on them? An answer would be of service to others as well as to—HILLSLAND.

STAYING TELEGRAPH POSTS.—*a b* and *c d* are two telegraph posts of equal height, firmly fixed into the ground. How can *m d* be



proved to be a stronger way of staying than *n x b*? Also, what is the compressing thrust on the strut *x y*, and the bending moment about *y*?—TELEGRAPH POST.—[An answer to this query appears in our letter column.—ED.]

Replies.

☞ Owing to the constant increase in our correspondence we regret that we have no alternative but to announce that we cannot reply by post to Queries even when stamped envelopes are sent.

☞ Queries and Replies must in all cases be accompanied by the names and addresses of the writers, as no notice will be taken of anonymous communications.

CRICHTON.—See our next issue.

E. M. R.—See reply to "M. D."

M. D.—No name and address given.

W. H.—See reply to "Kitchen Boiler" in our issue for April 29.

STEEL PLATE.—"Shipbuilding," by Pook, would no doubt suit you. It may be had from this office. Cost, 21s.

E. H.—6s. 6d. The work can be had from this office. You might try "Mill Work," by T. Box, 7s. 6d. This work may also be had from our office.

G. H. S. (Newcastle).—We had already commenced the article, so it is too late to do as you suggest. There will be no harm in doing as you say at the finish.

WALLACE.—The query is rather outside the province of this journal, but you may easily obtain the information you desire by consulting any of "Everitt's Patent Specifications" in the library of your town.

J. T. GRIFFITHS.—A bronze such as you name may be made by exposing to the air and repeatedly moistening with a little water fine clean iron filings, then boiling several times, and finally placing the mass in the sun or near a stove. A little nitric acid added during the last boiling will make the product more intensely red. The powder obtained should be freed from filings by washing.

Latest Inventions.

APPLICATIONS FOR LETTERS PATENT.

When Patents have been "communicated," the name of the communicating party is printed in italics.

Where complete specification accompanies application, an asterisk is suffixed.

8th August, 1892.

14,264 DESULPHURISING ZINC ORES.* P Hart.
14,271 METHOD of OBTAINING MOTIVE POWER from WAVES and TIDES. W S Potter.
14,288 STEEL INGOTS. J F Johnston.
14,296 ARC LAMPS. B Death.
14,302 MEANS for STARTING RAILWAY and TRAMWAY CARS. E J Knapp.
14,307 FIRE TUBE or WATER TUBE BOILERS.* R Müller.
14,309 ELECTRICITY METERS. F Teague and others.
14,312 CASKS. A Schott.
14,317 GAS ENGINES. W von Dechelhauser and H Junkers.
14,319 REFRIGERATING APPARATUS.* L Block.

9th August, 1892.

14,322 MACHINERY for FORCING AIR or other GASES. J C R Okes and W T Goold.
14,324 FILTRATION and PURIFICATION of WATER for DOMESTIC, SANITARY, and MANUFACTURING PURPOSES. W H Hughes.
14,327 COMPOUND STEAM ENGINES. A C Kirk.
14,331 APPARATUS for FEEDING BOILERS.* A Turnbull.
14,332 PACKING for USE in STUFFING-BOXES.* J A Fisher.
14,334 STEAM GENERATORS and HEATING APPARATUS.* J Wadsworth.
14,341 CONVERTING OSCILLATORY into RECIPROCATING MOTION.* J M Kelly. (*T A Briggs*, United States.)
14,345 MECHANICAL MOTOR. G H Jones.
14,353 WHEELS for VEHICLES and in PULLEYS for MACHINERY. H P Fenby.
14,360 ELECTRIC BELL. G Davis.
14,363 TRANSMITTING and RECEIVING TIME SIGNALS over MAIN and LOCAL ELECTRIC CIRCUITS.* W F Gardner.
14,366 TUBES for BOILERS. G Quick.
14,367 COMBINED HEATER and CLEANER for BOILER TUBES. G Quick.
14,370 DRYING the SLUDGE or RESIDUUM in the PURIFICATION of TOWN SEWAGE. J Lowe.
14,371 APPLICATION of COILED SPRINGS to or for MOTIVE PURPOSES. G A Chaddock
14,374 REFINING of PETROLEUM. J A Wanklyn and W J Cooper.
14,377 MOULDING or PLANING MACHINES for WOOD.* C L Goehring.
14,379 TOOL for CUTTING and SCORING CARDBOARD by HAND.* A J Boult. (*E Saltzkorn* and *L Nicolai*, Germany.)
14,380 MOULDING or PLANING MACHINES for WOOD.* C L Goehring.
14,382 MOULDING or PLANING MACHINES for WOOD.* C L Goehring.
14,385 MOULDING or PLANING MACHINES for WOOD.* C L Goehring.
14,389 BLOCK SIGNAL APPARATUS.* T H Patenall.
14,391 PUMPS.* H Maass.
14,394 SUCTION VALVES of COMPRESSORS and BLOWING ENGINES. J François.
14,395 ELECTRIC FURNACES for the TREATMENT of AURIFEROUS SULPHIDE ORES. J W Cann and R E Commans.
14,402 FURNACES for STEAM GENERATORS.* A Wilkinson.
14,406 SMELTING FURNACES.* H H Lake. *Oliver Aluminium Company*, United States.)
14,409 METALLIC DOWEL and MATRICE for MULTIPARTITE WOODEN CASTING PATTERNS.* F Schulte.
14,410 COMBINED FISHING and LIFEBOATS to be PROPELLED by HYDRAULIC MECHANISM. J F Green,

10th August, 1892.

14,419 MACHINERY for the CONTINUOUS REFINING of SUGAR. L E A Prangey.
14,423 ELECTRICITY METERS. A Wright.
14,434 GAS MOTOR ENGINES. W Rowbotham and J Bradley.
14,440 MACHINERY for CRUSHING, GRINDING, and WASHING METAL ORES, and for other purposes. B Miller.
14,452 CABLE TRAMWAYS. W N Colam.
14,454 APPARATUS for RAISING or FORCING WATER. P Davies.
14,456 APPARATUS DESIGNED for PREVENTING RAILWAY ACCIDENTS. A Fluss.
14,467 APPARATUS for TREATING, COMPRESSING, and FORMING PEAT FUEL. E Edwards and others.
14,471 CLUTCH.* J S Adams.
14,475 RAILWAYS.* E Perrody.
14,476 STEAM BOILERS. E T Bousfield.

11th August, 1892.

14,481 DECORATING CHANDELIERS, GASALIERS, etc. H Hateley.
14,489 GOVERNING DEVICES for ELECTROMOTORS. T Cuttriss.
14,490 ILLUMINATING GAS. B Parkin.
14,493 RAILWAY SIGNALS.* J Coleman and others.
14,495 MACHINE for BREAKING PIG-IRON. W Truran.
14,511 WATER GAUGES and STOP COCKS. J Farmer and others.
14,516 ELECTRIC or OTHER FLASHING SIGNAL LAMP. H W C Baker. (*L C Baker*, H.M.S. "Mercury.")
14,533 APPARATUS for CONVERTING ALTERNATING CURRENTS of ELECTRICITY into DIRECT CURRENTS. R M Lucas and A G New.
14,547 STEAM BOILERS.* J B Furneaux and E Bennett.

12th August, 1892.

14,552 MARINE BOILERS. R Welford.
14,555 VENTILATING FANS. W G Walker.
14,558 LAMPHOLDERS for INCANDESCENT ELECTRIC LAMPS.* C M Dorman and R A Smith.
14,560 MECHANICAL MOVEMENTS. F P Hummel.
14,563 STATIONARY LUBRICATOR for the BEARINGS of ECCENTRICS. J Toinko.
14,567 GROOVED WOOD CASES for ELECTRIC CABLES or WIRES. S Hindley.
14,569 DIVIDING, COMPARING, and MEASURING COMPASSES. R D Melrose.
14,570 STOPPERS for LADLES used for CASTING STEEL. J Stranaghan.
14,578 SIGNALLING APPARATUS. F J Gallaher.
14,579 BRONZE ALLOYS. A K Huntington and R T Preston.
14,582 ENGINES to be WORKED by HOT GASES. E Field.
14,586 APPARATUS for REMOVING when CASTING GASES and IMPURITIES contained in the METAL or ALLOY.* J L Sebenius.
14,597 AUTOMATIC PRESSURE-REDUCING VALVES. H Lane and J Pullman.

13th August, 1892.

14,620 DRAWING BOARD. C J Pavitt.
14,621 DOUBLE-ACTING LIFT and FORCE PUMP. A E Johnson and F Willans.
14,623 PROCESS for ROLLING and DRAWING TUBES. A E Hills.
14,629 MACHINES for MOULDING and SAWING WOOD. G Cameron and J Hansell.
14,640 STEAM-GENERATOR FURNACES. G Holding.
14,647 APPARATUS for CONTROLLING the ELECTRIC CURRENT on PUTTING ELECTROMOTORS in CIRCUIT. Siemens Bros. and Co. Ltd. (*Messrs. Siemens and Halske*, Germany.)
14,650 HYDRO-CARBON ENGINES. T C Hogg and D W Forbes.
14,658 ELECTRIC ACCUMULATORS or SECONDARY BATTERIES. A J Smith
14,659 ELECTRIC ACCUMULATORS. H H Lake. (*F C Jenkins*, Germany.)
14,660 PLATES for ELECTRIC ACCUMULATORS. J Rousseau.
14,668 SHAFT COUPLINGS. V H Cruse.

Manuscript Specifications of Patents can be examined at the Patent Office, London, after the Complete Specification has been accepted, on payment of 1s. The printed Specifications are usually published in about one month after acceptance of the Complete Specification, and any single copy may be obtained by remitting 8d. in stamps (or by special post cards sold at the Post Offices at 8d. each) to SIR H. READER LACK, *Comptroller General, Patent Office, 25, Southampton-Buildings, Chancery-lane, London. When a number of Specifications are required, remittances may be made by P.O.O.*

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☞ THE MECHANICAL WORLD *is published every Friday at 391, Strand, London, and at New Bridge Street, Manchester. It is particularly requested that business communications from the Provinces be addressed to the Offices at New Bridge Street, Manchester, and London communications to 391, Strand. Letters referring to Editorial matters should in every instance be sent to the Manchester Office.*

FRIDAY, SEPTEMBER 2ND, 1892.

Water Power in Ireland and Scotland.

SEEING that the utilisation of water power for all kinds of driving purposes is a subject which is daily receiving more attention, especially on the Continent and in America, it is somewhat surprising that more interest has not been taken in this source of power as applied to modern purposes in the districts nearer home. Our remarks in the present instance are applicable more particularly to Ireland and Scotland, both of which countries possess many natural, and with a few exceptions almost unequalled advantages, yet we are not aware that in either of these countries any very great use has been made of the splendid sources of power which are at the present time running to waste. It is therefore time that Irish and Scotch engineers should exert their influence and energies in the direction of providing for the utilisation of these latent powers that lie around them waiting to be used—powers which may be employed for a great many manufacturing purposes by means of electrical transmission, and not only for electric lighting installations, which are rapidly increasing in number day by day. Perhaps it may be of interest to mention that Switzerland, which is somewhat similar to Ireland and Scotland with regard to the nature and extent of its large latent resources in water power, has been most extraordinarily successful in its application of this power, as will be seen from the following abstract from a Foreign Office report which has just been issued. The report says that "the manufacturing interests of this country mainly depend upon their rich water resources. Of the 2322 factories which employed motive power at the close of 1888, 1114 exclusively employed water power, and only 658 exclusively steam power, while 457 employed both water and steam; and, taken altogether, these 2322 factories used 54,243H.P. of water and 27,432H.P. of steam, and only 717H.P. of gas. The facilities which science is daily multiplying for the transmission of force by electricity, recently exemplified by the Lauffen transmission exhibited at Frankfort, are likely still further to accentuate this special feature in Swiss industry." Our readers will remember that we have frequently referred to the Lauffen transmission plant in these columns, and to the possibilities which it has demonstrated of transmitting large powers to long distances. Quite recently we have had an addition to the small number of electric-light installations driven by water power in Scotland, in the shape of a plant for generating electricity for lighting Overtoun, Dumbartonshire, the fine baronial residence of Mr. J. Campbell White. The installation consists of 300 lights of 16C.P. The water from the hills is gathered into a reservoir capable of holding 700,000 gallons, and from which it is conducted by means of a 12in. cast-iron pipe a distance of 640yds. to a turbine and dynamo house at the foot of a glen, the fall being 170ft. There are two Thomson turbines, each of which is capable of driving the whole installation, and these are coupled direct to dynamos of the Mavor and Coulson type, running at 1000 revolutions, the voltage being 135 and the ampères 75. We have no doubt that the number of installations of this kind will rapidly increase in the near future, especially when it comes to be understood that such plants as these invariably pay for their first cost in three or four years, whilst the upkeep is but slight.

Electric Lighting in the City.

BY the 5th November next, the contracts for the electric lighting of the City of London must be completed, and judging from the rapid progress which the company is now making it is fair to assume that the agreements will be practically carried out. The two generating stations already contain plant capable of supplying 700 public arc lamps and 23,000 incandescent lamps of 8C.P., including reserve, whilst additional machinery of a capacity of 56,000 8C.P. lamps is being constructed. At the end of June 184 street arc lamps were in use, and these have since been increased, and by the middle of September the majority of the lamps contracted for will be in operation. With regard to glow-lamp illumination, applications have already been made for over 32,000, and of this number about 12,000 are connected. Fleet-street is now practically ready, and before the dark days fully arrive the City should be one of the best lighted in the world.

The Purification of Coal Gas.

THE use of oxygen in the purification of coal gas is regarded as one of the important purposes for which the former gas, as commercially manufactured, may be employed. In this connection it may be of interest to briefly refer to the fact that at a recent meeting of the Manchester District Institute of Gas Engineers a paper was read by Mr. T. Stenhouse, the borough analyst of Rochdale, on "The Behaviour of Oxygen when Air is used in the Purification of Coal Gas." He stated in the course of his paper that many experiments had been made at the Rochdale Gasworks to ascertain how oxygen and air behaved in their passage with the crude gas, through not only the purifying boxes, but the scrubbers and washer as well. Of course, from a chemical point of view it may appear altogether wrong to admit oxygen or air to coal gas before the latter has passed the scrubbers, as one would think that the gas liquor and tarry matters, containing as they do so many compounds capable of oxidation, would assimilate the oxygen long before the purifiers were reached. Such is not the case, however. The union of oxygen with the substance referred to depends largely, if not entirely, on the temperature. No added oxygen, or only an infinitesimal quantity, is absorbed in the washer and scrubbers. In some works it will be found much easier to add air or oxygen before the gas reaches the scrubbers than afterwards. When this is the case there need be no fear of oxygen being wasted. To obtain the best results in purification by the aid of air or oxygen, there can be no doubt that a large purifying area is a great advantage. The use of air or oxygen lessens the offensiveness of the fouled or spent lime, besides rendering a box active for a longer period. It also diminishes the sulphur compounds in the purified gas. The question arises, however, whether we do not pay too dearly for the advantages owing to the depreciation of the quality of the gas, due to the presence in it of the nitrogen of the air used. This is a point which requires investigation.

Self-contained Electric Tramcars.

TRACTION by means of self-contained electric tramcars seems hitherto to have been very unfortunate, though there is little doubt that the system is the one most suitable for dealing with urban traffic. The method of conveying the current by overhead wires will hardly be tolerated in large towns, although, as is the case at Leeds, it may be adopted in a suburban district. On the other hand, underground systems of collection are lamentably backward, and one inventor, Mr. A. L. Lineff, whose closed-conduit system will be familiar to our readers, and who for various reasons has been prevented from getting it adopted in this country, is now in the United States, where he hopes to readily get that method introduced. Coming again to consider storage-battery cars, we find the present position anything but enviable. The cars which had been in operation on a section of the North Metropolitan Tramway Company's system at Barking for over two years, have ceased running, the contract being terminated with the contractors by the directors of the former company. The reason for this is, we believe, to be found in the breakdowns of the cars due to the defective condition of the line, which was not kept in proper maintenance. If this is true (and our recollection of it is that the line was hardly suitable for heavy cars), no wonder difficulties arose. In the other Metropolitan suburb (Croydon) where two cars on the Jarman system have been tested, the licence granted for six months has expired, and the cars have been withdrawn. The company is, however, undergoing a process of domestic reconstruction, and it is probable that further experiments will be made on a subsequent occasion. In Birmingham, where the Central Tramway Company have in operation cars on the cable, steam, horse, and accumulator systems, the non-success of the latter has been attributed as being partly the cause of the unsatisfactory financial position of the company. The running of the cars during the past year has resulted in a serious loss due to the heavy charges for renewals of the batteries and permanent-way repairs. To improve matters the company have entered into a contract for the maintenance of the batteries at one penny per mile run. We do not know whether this refers to the E.P.S. cells or those of the Epstein type, which it is intended to employ. At all events, with a guaranteed rate for renewals the expenses per car mile should be reduced. We cannot help thinking that most accumulator cars are built too substantially, and as far as we have seen only one type of car has been constructed light and yet capable of meeting the demands made upon it; this it has done up to the present. With the improved types of cells about to be used, with lighter cars, simple gearing, and efficient management, storage-battery cars should be able to compete with horse cars. Surely in this country, where self-contained cars have been experimented with more than anywhere else, a really good system can be evolved; or are the Americans, who have eclipsed us in the trolley method, and who are now paying greater attention to accumulator traction, going to surpass us in the latter?

The Prevention of Smoke from Locomotives.

WHILE the prevention of the emission of smoke from mill and factory chimneys is a problem which is constantly receiving the attention of municipal authorities on the one hand and a host of enthusiastic inventors on the other, the locomotive appears to enjoy almost absolute immunity in this respect, at any rate so far as this country is concerned. We have on a former occasion referred to the energetic attempts which have been made within the last few months to mitigate the smoke nuisance in Chicago, especially as regards the locomotives entering that city. On one of the lines — the Chicago, Burlington, and Quincy — a small supply of coke is allowed each engine entering Chicago, and by the use of this smoke is prevented until the train has passed the city limits. It is said that no complaint is made against those railways who are using the smoke-preventing devices recommended by the city authorities, although in many cases the evil is not reduced in the least degree. In fact, some railroad officials have said that the cheapest way to get rid of the trouble caused by complaints was to use the devices recommended, and that it was not so much a question of reducing the smoke as of using favoured devices. The apparatus generally applied to locomotives in Chicago consists principally of a steam jet, which will only remove smoke under certain conditions. Coke is certainly the easiest way out of the difficulty for those engines that come into the city only at the end of trips, as but a small amount is required to reduce the smoke to a reasonable degree. Probably more will be heard of this matter in the near future, as the stringent enforcement of regulations for suppressing the smoke nuisance commenced on 1st September.

Messrs. Ernest Scott and Mountain Limited.

MESSRS. ERNEST SCOTT AND MOUNTAIN LIMITED, Close Works, Newcastle-on-Tyne, are extremely busy in both their electrical and engineering departments. In the former department they have just secured the contract for the lighting of the Co-operative Wholesale Society's premises in Waterloo-street and Thornton-street, Newcastle-on-Tyne. This installation is perhaps the largest driven by gas engines in the kingdom, the plant consisting of three 25H.P. nominal gas engines, to give 55 effective horse-power each, three Tyne compound-wound dynamos, to run 400 16C.P. lamps each, and about 800 16C.P. lamps fixed throughout the premises. In addition to this, the firm have the contract for lighting the Ashington Colliery throughout, and are also lighting Messrs. Chadwick Brothers' mill in Russia. They have more recently secured the contract for the electric pumping plant for the Newton Colliery Company. This plant is to be capable of delivering a maximum of about 200 gallons of water per minute. In the engineering department they are extremely busy with specialities in connection with auxiliary machinery for warships. They have in hand for the Admiralty six duplex pumps of the Worthington type with cylinders 9×6×9; they have also in hand an order from the India Office, for their Admiralty type of pump, and are building a considerable number of this type of pump also for various contractors doing Admiralty work. They are also busily engaged with fans, having recently secured orders for a considerable number from various firms.

MEM. FOR ADVERTISERS.—The chan[illegible] ments in THE MECHANICAL W[illegible] those of any other engi[illegible] circulation, and not o[illegible] competitors.

Engineering Pattern Making.

By a Foreman.

XXIII.

We shall now describe how the pattern should be prepared for "splitting." We shall first take a rope pulley with a single groove, and one which must be provided with lugs on the bosses and rim for the purpose of bolting the halves together.

These in no way interfere with the moulding beyond the extra time required to put the "splitting plates" in the mould. The three-parted moulding box is used as before, and in patterns leaving their own core, and which are in *halves*, the lugs on the rim must be jointed in the same line as the pulley; but where the groove is formed with cores this is optional.

"Splitting plates" are of either cast or sheet iron, $\frac{1}{8}$in. or $\frac{5}{16}$in. thick. Fig. 152 shows one of each of the plates required for the boss and rim.

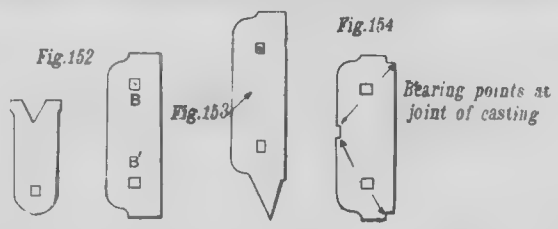
A thin wooden or cardboard templet is usually cut out by the pattern maker of the shape required, the bolt holes B being also cut in the correct position. Cast-iron plates are more quickly made than wrought-iron, which require to be filed up to the templet, as they must fit the outline when placed in the mould; otherwise a crushing of the mould will take place, and this in a rope-pulley mould often means considerable loss of time, as the thin section of sand forming the groove is particularly liable to damage, and as a protection against unnecessary trouble it is advisable to try the templet in the mould. Before the plates are placed in the sand they are daubed over with a thin mixture of loam and blacking, mixed, and then dried, or a coating of gas tar is used, either of which prevents the hot metal from burning the plates away. Short pieces of core are put through the holes B, B^1, equal in length to the width of the lugs, though in some cases drilled holes are specified, which dispense with the holes through the plates.

A thin print across the centre of the boss is useful, preventing the plates from being disturbed, and saving the trouble of securing them at the bottom with sprigs, though in some cases a spike on the end of the plate (Fig. 153) serves the same purpose; but this is not applicable to the splitting plates on the rim of the rope pulley just described. Again, the thickness of these plates is not arbitrary, but is subject to the section of the pulley rim and boss, as much as $\frac{1}{4}$in. thick being used for large pulleys of heavy section, and it is entirely a matter of opinion whether the plates should cover the entire surface of the rim and boss section, as in Fig. 152, or whether they should have "bearing points," formed by cutting out the plates, as shown at Fig. 154. We are rather inclined to the latter, as a cleaner hole can be bored than when the plate cuts through to the core, and the plates can be used frequently if a number of castings be required, there being no necessity to leave the plates in the pulley when it is bolted together, as it retains its diameter without them. Any number of grooves may be similarly split by the extension of the splitting plate, and as we think there has been sufficient explanation to render the method perfectly clear, we now propose to show how strap pulleys may be prepared and how they are "stopped off" or made wider than the actual pattern width by what is termed "drawing" or "rising."

The first example is a 24in. pulley 16in. wide, which is to be made from a pattern of 10in. width, thus requiring the same to be raised 6in. For this purpose we shall require a three-part moulding box, the middle part of which must be greater in depth than the pattern. The latter is moulded in the following manner:—

On the edge of the bottom part of the moulding box (Fig. 155) two strips of timber S, S^1 are laid equal in depth to half the extra width required—viz., 3in. A mound of sand is made above the joint line or edge of the bottom part box, and a little larger than the pattern in diameter. The sand is then strickled off level with the top edge of the strips, and upon this face the pattern is laid after the entire surface of the sand has been freely sprinkled with parting sand. The middle part is then put on and the pattern rammed up to the top edge. Then by means of a strickle (Fig. 156) a joint line J is formed in the middle part corresponding to the height the pulley is to be raised through this particular box part. After the joint J is made it is in turn prepared with parting sand, and is then ready to have the top box T placed over the pattern.

Previous to being rammed up it must be well "gaggered" in order to support the large mass of sand it is required to carry. The inside diameter of the raised sand above the top edge of the pattern is equal to the inside diameter of the pattern, and is formed by the moulder scraping away the sand to the right size by means of a strip of wood held against the inside edge of the pattern. The side, after being sprinkled with parting sand, forms a matrix of the proper depth and diameter, out of which is formed the projecting sand in the top-part moulding box. It is also usual to make a taper joint, as shown by the lines marked K, K^1. This is done to enable the top part to be more easily detached than if the horizontal joint line J were carried forward to the side of the moulding box, as if this were done the inevitable result would be to damage the top part when an attempt was made to lift it. After the top part has been rammed up and



detached from the middle part, the sand which formed the sides of the matrix above mentioned is cut away for about an inch on each side to allow the pattern to be raised, and also to allow of a layer of "facing" sand to be put between the pattern and the part cut away. The pattern is then raised to the level of J by means of a hook or eyebolt, which is usually screwed into a nut on the underside of the pattern. This enables the pattern to be supported by means of a bar passed through the eye-bolt and packed up to the correct height by a few rough pieces of timber and wedges resting on the edge of the middle part.

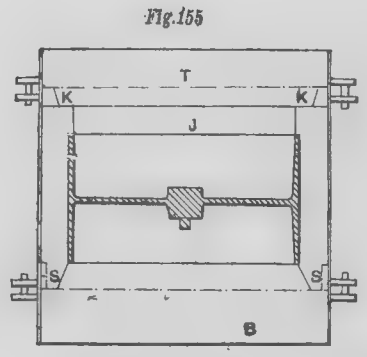
The outside is then rammed level with the line J, the pattern is then drawn, and the operation is complete. Thus the width of face may be increased *ad lib.*, and at the same time the arms or plate kept central.

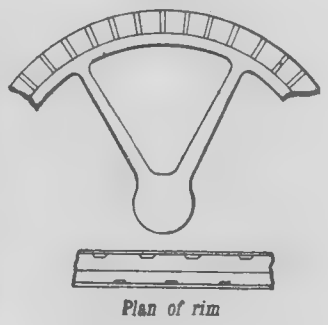
Before concluding this article the pattern of a chain pulley must be taken into consideration. Fig. 157 represents one usually employed for hoisting blocks or crane work. In this class of work the links of the chain are made equal in distance, thus giving a certain pitch to the chain, and so enabling each link to lie in the recess formed to receive it.

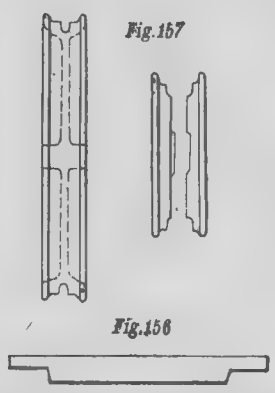
The ordinary V-groove rope pulley is often used as a chain pulley by the addition of small strips cast at intervals round the sides of the V-groove as shown at Fig. 160, the purpose of these pieces being to assist the "bite" of the chain, and prevent slipping. In this case the ordinary kind of chain is used as the "chain bits," or pieces may be set at any pitch between 2in. and 3in. that will equally divide round the circumference of the pulley.

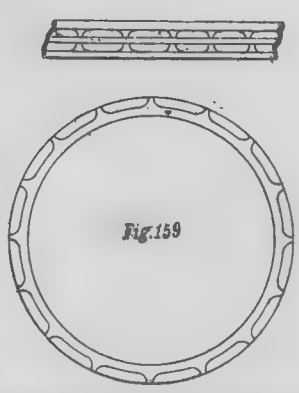
It is necessary when making the pattern for a pitch-chain pulley that a piece of the chain to be used should be tried in the pattern, as by this means the corners of the pattern can be pared to suit any slight irregularities which occur in the welding of the chain links. Other forms of chain pulleys having projections set on the periphery, and used at set distances to transmit motion, are so closely akin to tooth wheels, requiring a special form for the teeth, that we think it better to include them in the article on gearing.

(To be continued.)









The diameter of the pattern being given, two pieces of well-seasoned timber should be picked, out of which to make each half of the pattern. The joint sides should be first turned and fitted together; a centre peg on the one half, with a recess on the other, will ensure their correct relative positions, and provide a means of setting while the opposite side is turned to the required section.

Figs. 158 and 159 show the plan and elevation of the pulley groove, and by reference to the latter it will be seen that only a portion of the groove can be turned, the other having to be cut, as the links will have to rest on a polygon, the sides of which are equal to the length of the chain link, and the pitch equalling the distance from centre to centre of the alternate links.

On the Applications of Electricity in the Royal Dockyards and Navy.

(*Continued from page* 79.)

Temporary Installations.—The employment of temporary installations of electric lighting in ship building and repairing has been a marked feature of recent practice in Portsmouth dockyard. Probably more has been done here in this respect than has been attempted in any other royal dockyard or private shipbuilding yard in the country, although these are now finding it to their advantage to follow the lead. So highly satisfactory have been the results of the experiments in this direction, that, with the exception only of the smallest ships, the electric light is now installed as a matter of course on board every new vessel at an early stage of its construction, and also in all vessels where repairs of any magnitude are to be carried out. The character of these temporary installations varies with the circumstances of each case. Where vessels are building in the docks adjacent to the electric shop, it is more convenient and economical to supply the current from a dynamo in the shop itself, the leads being carried to the ship on temporary wooden poles put up for the purpose. Vessels building on the slips, which are too far from the electric shop to convey the current to them in an economical manner, are served by a dynamo and motor placed at some convenient spot near the ship. After a vessel is launched, and generally for all vessels afloat, the most satisfactory method is to place a dynamo and engine with a steam boiler in the ship itself, generally in a temporary wooden house on the upper deck. By this means the light is maintained without interruption during the many movements of the vessel about the basins. The leads, lamps, etc., are fitted roughly. The cables are simply tied to clips fastened to the beams, etc. The switches are hung from the cables. The lamps with their holders are secured to wooden bases, and protected by wire guards without any glass globes.

Cost.—Although no exact comparison can be given between the cost of this mode of illumination and that of the old plan of lighting by candles, it is estimated that in a first-class cruiser like the "Royal Arthur," the total cost of the electric lighting during the whole period of building, including depreciation of plant, would be about £1200. This would probably not much exceed, if at all, the cost of candles for the same period; but the vastly superior illumination obtained by the electric light—enabling work to be done better, more quickly, and under better supervision, to say nothing of the advantages in health and comfort to the workmen—would justify the continuance of this system, even though the actual cost should be much greater than that of lighting by candles. It is hardly an exaggeration to say that the excellent results as regards celerity and cheapness of construction, which have lately been attained in Portsmouth dockyard, could scarcely have been realised without the aid of the admirable illumination afforded by the system of incandescent lighting.

Testing of Dynamos.—Before acceptance from the makers all the dynamos purchased by the Admiralty are tested on receipt at a dockyard; and as no less than 150 have been tried at Portsmouth during the last two years 1890 and 1891, the experience gained has been considerable. At the north end of the electric shop a space is fitted with cast-iron holding-down plates, of sufficient area to take several sets of plant at one time, and also with an overhead traveller for lifting. Steam at 100lb. per square inch, or other pressure required, is supplied by three boilers of locomotive type in the adjoining boiler-house. Adjacent to the holding-down bed is a separate enclosed room, containing all the various electrical testing instruments, and into this room the leads from the dynamos under test are taken. For enabling a dynamo on any part of the holding-down bed to be rapidly connected up with the instrument room, two bare copper rods, extending overhead the whole length of the bed, are fixed to the roof trusses and insulated by slate. From these are suspended two hanging leads, the lower ends of which can be connected to the terminals of any dynamo under trial. The overhead bars are coupled to leads, which pass through resistances sufficient to give the full load, and then into the instrument room.

Nearly all the dynamos now purchased, except those for torpedo boats, are of a capacity of 400 ampères at 80 volts, the latter being the Admiralty standard voltage for all dynamos and electrical fittings; and they are all direct-current and compound-wound. The dynamos are coupled direct to open vertical compound engines, working generally with 100lb. steam pressure at a speed of about 330 revolutions a minute. The dynamo and engine are required to stand first a continuous trial of six hours' duration with full load. Every half hour the steam pressure, current, and electromotive force are recorded, as are also the temperatures of the testing-room, field magnets, and armature.

It is stipulated that one minute after the end of the trial the temperature of any accessible part of the machine must not exceed that of the testing-room by more than 30° F.; and the maximum temperature of the armature at end of trial after stopping must not exceed that of the room by more than 70° F. If these limits are exceeded by more than 10° the machine is liable to rejection. These tests for temperature are considered to be of great importance, for if unsatisfactory the dynamo is not likely to remain long efficient. The spare armature which is supplied with each machine is required to undergo a similar test for two hours. The current produced by any dynamo is measured by means of a Siemens ammeter; and as a check upon this the current can also be switched on to a Siemens dynamometer. There are several of these ammeters, and three dynamometers, of different sizes to suit the current to be measured. The leads pass through sliding resistance boxes, so that the strength of the current can be varied as required for the compounding trials. The voltmeter

leads taken from the dynamo terminals are also led into the instrument room, and the electro-motive force is ascertained by means of three Evershed marine voltmeters. A switch is interposed, of such a nature that either any one or any two or all three of these voltmeters may be in the circuit, thus checking one another's accuracy. A Cardew voltmeter and also a Siemens voltmeter can be switched in if desired. The Cardew voltmeter and the Siemens ammeter are the instruments actually used on board ships of the navy. Very delicate instruments, such as electro-dynamometers, are found not to be suitable for use under such circumstances. As additional tests the engines and dynamos are expected to stand without injury the sudden removal of the full load by the breaking of the circuit; and under such circumstances the maximum increase in revolutions or in voltage must not exceed 25 per cent. The dynamos are required also to be compounded so as to give a constant electro-motive force of 80 volts when the current is varied from 400 to 10 ampères, the speed being fairly constant during the time; and they are fully tested to ascertain that these conditions are fulfilled.

Engines.—As regards the engines, great importance is attached to their economy in the consumption of steam. The makers are required to state the consumption of water per electrical horse-power per hour which they will guarantee shall not be exceeded. A fine is incurred for every pound of water per electrical horse-power per hour in excess of the maximum guaranteed; and if the excess amounts to more than 10lb. per hour, the machine is liable to rejection on this account. The water used is carefully measured, and every endeavour is made to avoid losses by leakage of steam, etc. Importance is also rightly attached to the governing arrangements, and it is stipulated that the increase of speed when the load is gradually removed must not exceed 5 per cent.

Resistances.—Before the six hours' trial is started, and immediately after its conclusion, the resistances are observed of the dynamo complete, of the armature, and of the shunt and series windings of the field magnets; the resistances are thus obtained both when the circuits are cold and also when they are hot. For this purpose the leads from the terminals of the part whose resistance is required are taken into the testing-room, and the resistances are obtained by a bridge made by the Silvertown Co., by a Thomson's marine galvanometer, and by an ordinary scale, for which the light is given by an incandescent lamp behind. The ordinary Daniell cells are used, and a key is introduced, so that one, two, three, or four cells may be switched in at once without altering the leads.

The dynamo and engine are further tried when fitted on board ship, and when the whole installation is complete.

(*To be continued.*)

Machine Construction.

THE CONSTRUCTION OF MACHINE ELEMENTS.

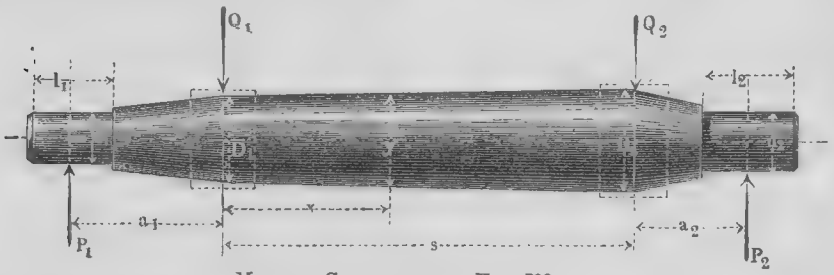
(*Continued from page* 79.)

§ 134.

AXLES LOADED AT TWO POINTS.

IN an axle loaded at two points, as in Fig. 398, the end portions are called the shanks, and the middle part the shaft. If Q_1 and Q_2 are the loads, s the length of shaft, we have for the journal pressures—

$$\frac{P_1}{Q_1} = \frac{s + a_2\left(1 + \frac{Q_2}{Q_1}\right)}{a_1 + s + a_2},$$



MACHINE CONSTRUCTION.—FIG. 398.

$$\frac{P_2}{Q_2} = \frac{s + a_1\left(1 + \frac{Q_1}{Q_2}\right)}{a_1 + s + a_2} \quad \ldots\ldots\ldots\ldots (125).$$

If we take the diameters corresponding to these pressures as d_1 and d_2, and also have the shanks a_1 and a_2 given, we may determine next the diameters at D_1 and D_2 at the points of application of the loads Q_1 and Q_2.

To find the diameters of the shaft at various points we have, taking y for the diameter at any point distant x from the load point Q_1—

$$\frac{y}{D_1} = \sqrt{1 + \frac{x}{a_1}\left(1 - \frac{Q_1}{P_1}\right)} \quad \ldots\ldots\ldots (126)$$

an equation which gives the shaft the outline of a double cubic parabola, which in practice may be replaced by two straight lines, giving the shape a truncated cone.

The two seats for hubs are formed so as to give shoulders for keyway, and have a determinate breadth b, governed by the piece to be carried. In many cases such axles are symmetrical, and the two loads are equal to each other, hence $a_1 = a_2$, $Q_1 = Q_2$. We then have $P_1 = P_2 = Q_1 = Q_2$ and $y = D$, the shaft being cylindrical. This is also the case when $P_1\, a_1 = P_2\, a_2$.

The graphical solution of the preceding problem is as readily made as in the case of single loads. If we draw normals to the axis A D, Fig. 399, corresponding to the given loads Q_1 and Q_2, also draw A a, make $a\,1 = Q_1$ and $1\,2 = Q_2$, choose a pole O and draw the rays O a, O 1, O 2, prolong a O to its intersection b with the line of the force Q_1, make $b\ c$ parallel to 1 O, $c\ d$ parallel to 2 O, and join d with a. Draw O 3 parallel to $d\ a$ in the force polygon, and we have $2\ 2 = P_2$, and $3\ a = P_1$, and $a\ b\ c\ d$ the surface of movements whose vertical ordinates t may be used to determine their corresponding diameters of the axle as in I., § 132.

The intersection e, of $a\ b$ and $d\ c$ prolonged, determines the position E e of the resultant of Q_1 and Q_2. If E e is desired at once, as in the method given in § 40, the previous case (§ 132, I.) is applicable, since the direction of the line $a\ d$ can be chosen at will.

If one load acts beyond the bearings,

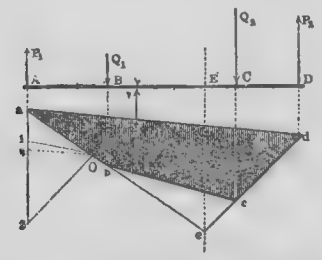


FIG. 399. MACHINE CONSTRUCTION.

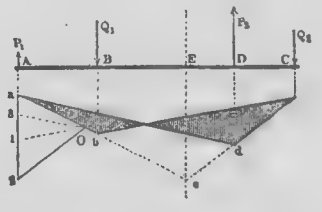


FIG. 400.

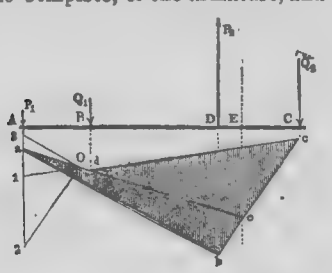


FIG. 401. MACHINE CONSTRUCTION.

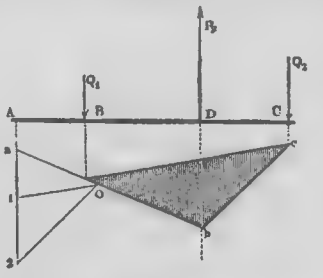


FIG. 402.

Fig. 400, the reversal point in the elastic line will appear as before; this occurs when the resultant of Q_1 and Q_2 falls between A and D (see § 132, I.). The above mentioned shearing stress is given by 1 3.

If the resultant of Q_1 and Q_2 falls outside both journals, Fig. 401, there will be no reversal, the force P_1 having the same direction as Q_1 and Q_2; in other respects the procedure is the same as before.

Finally the resultant may just equal the force at D, as in Fig. 402. In this case there will be no bending stress in portion A B, which in the previous case was quite small, the two lines of the surface of moments falling together. The shank A B and the journal at A may therefore be made very light, unless other forces than those already considered act upon them.

The decomposition of the forces acting upon the hub-seat depends upon its breadth, and the treatment is similar to § 132. Other variations may occur in the relations of the loads and journals, but the preceding examples will suffice.

(*To be continued.*)

The Under-type Stationary Engine.—XVIII.

IN future articles we purpose illustrating two examples of locomotive multitubular boilers, such as are used either alongside of the separate engine or placed above the engine in the usual style, and it may serve a useful end if we preface these articles with a few notes on this type of boiler.

The locomotive boiler has during recent years unmistakably risen in favour among steam users. It is now employed in printing offices, and in many manufactories which need not be enumerated. It has in numerous instances supplanted the Cornish or Lancashire boiler, and it is often preferred to any other type for electric-lighting purposes. We could name several establishments in London and the provinces where batteries of large locomotive multitubular boilers are used for generating steam for engines of considerable power. This boiler is pre-eminently adapted for temporary works of any character, it requires no expensive brickwork setting or foundations, it takes up little room, and given fairly clean water it will run for years without risk or occasioning any trouble. We have in our mind some very large locomotive boilers that have been in constant use for over twenty years; they have been well looked after and periodically washed out, and are now in good working order. This instance is mentioned to show that the confidence recently evinced in favour of the locomotive boiler has not been misplaced. Beside the advantages we have already enumerated, the locomotive boiler is an economical steamer, as it will evaporate considerably more water per pound of coal than the Cornish boiler. The exhaust steam from the engine can be turned into the chimney for increasing the draught, and the firebox can be made large or small to suit any kind of fuel. It will be seen that this type of boiler has many advantageous features. But we regret to say that the boiler work of some well-known firms reveals some grave points of weakness that we shall presently notice.

A great deal of attention has been bestowed on the design and construction of steam engines, but the boiler and its details have never received the drawing-office care which their importance really demands. "The generation of steam under pressure is, and must remain, one of the most important factors in the successful employment of steam power, for not only is the value of an engine regulated very considerably by the pressure and dryness at which the steam can be safely and conveniently supplied to it, but there is much greater scope for the exercise of economy in the boiler than in the engine, while the still more important point of absolute safety must not be lost sight of for a moment. It is, therefore, somewhat surprising that the steam boiler has been comparatively neglected in comparison with the attention bestowed upon the steam engine; this, however, appears to be due to the fact of the latter having greater attractions for the engineer, the improvements in the boiler being simply required to keep pace with the advance in the engine."*

There are only three or four firms in England which turn out first-class, thoroughly well-made locomotive multitubular boilers, suitable for the undertype engine, and properly equipped for making high-pressure steam. We have numerous makers who build fairly creditable boilers, but close observation reveals some dangerous abortions. In some engineering works the calculations employed for proportioning the boilers consist of a prodigious array of figures, it is true, but common sense and practical experience are sadly lacking in their productions. Locomotive boilers built to such designs have their flat surfaces riddled to death with stays, but the distance between the bottom row of tubes and the top row of stays in the saddle plate is rarely provided with palm stays. The end plate is badly stayed; but the manhole is most frequently the greatest source of weakness in these second-rate boilers. It will cause some astonishment among our readers when we state that we recently examined some large locomotive boilers strongly built of heavy plates, the staying and riveting apparently being intended for over 100lb. working pressure, and the manholes in these boilers were of the ordinary type (as used for small boilers and low pressures)—viz., a hole cut in the barrel plate about 10in. by 13in., with a strengthening ring of ½in. plate, double riveted on the outside. But when the boiler happens to be satisfactory as regards the staying, possessing a manhole of approved design, how often such a boiler is simply spoiled by the disgraceful fittings! Some firms appear to think that any sort of odds and ends when mounted on the boiler will pass muster; these ancient and unsuitable details are made to badly serve most important ends. It is somewhat unfortunate that the under-type engine and locomotive boiler are made by firms engaged in the manufacture of portable engines, because we frequently see on large boilers poor little safety valves that were got out 30 years ago for portable engines, when these engines were working at 45lb. pressure. We have seen large locomotive boilers equipped with a miserable little lock-up safety valve, which will most likely be stuck fast in a few weeks' time; and in addition to this, another equally faulty safety valve, of the spring-balance type, which is condemned by all modern engineers. Both these worthless fittings should be relegated to the scrap-heap at once.

Years ago it was customary to bolt the fittings direct to the boiler plate, but this practice is abandoned by all the best makers. It is true, there are some engineers who still cling to this defective method, and seeing that they have sent out their boilers in this antiquated style for the past 20 years, we see no prospect of an alteration.

Do not the above remarks prove to demonstration that in many cases the boilers are sadly neglected?

But we must now show more excellent methods of construction. All the fittings are now bolted to some faced block or standpipe firmly riveted to the boiler, the blocks being of such a thickness as to raise the flange joint just above the lagging. Fig. 27 shows a good example. It consists of a block of wrought iron 2in. thick in the middle, secured to the boiler by means of deeply countersunk rivets round the outer edge, as shown. The studs for bolting the flange of the fitting to the block must be arranged to come between the rivets. Cast-steel blocks of this type have been tried, but owing to the existence of blowholes they often leak. Another type of raised block is shown at Fig. 28. It can be formed of steel plate under hydraulic pressure. If made of thick plate, to allow for facing, it is a fairly satisfactory job. Two small holes should be drilled as shown to allow any condensed steam to escape. Of the two fixings we prefer Fig. 27 when made of wrought iron.

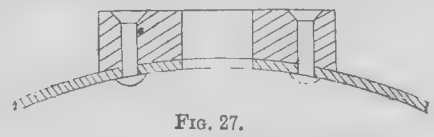


FIG. 27.

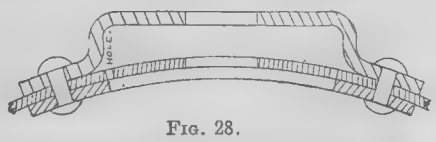


FIG. 28.

Cast-iron seating blocks are no longer used by first-rate makers. For small boilers the manhole may be made like Fig. 28, pressed out of a ⅜in.-thick steel plate, the hole cut an oval shape, and the lid fitting inside, with two cross-bars outside. A strengthening ring should be riveted round the hole in the inside of the boiler. For larger-sized boilers a raised wrought-iron welded manhole should always be used, as shown in Figs. 17 and 18 (see MECHANICAL WORLD, 25th March, 1892). These raised manholes are made of steel or iron plates about ⅜in. thick, about 16in. diameter, the bottom flange double riveted to the boiler, and the top flange faced to receive the dished wrought-iron or cast-steel ribbed lid, which is secured to the top by means of 1in. bolts and nuts about 4in. pitch.

(*To be continued.*)

* "Boilermaking by Machinery." Galloway, 1889.

Sugar-making Machinery: XVIII

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In cattle mills the rolls are driven by means of bevel wheels, the larger wheel being keyed on the vertical spindle and generally driving on top side of pinion keyed on top roller gudgeon, the roller pinions being keyed on the opposite end of their respective gudgeons. Table XII. gives the leading dimensions of this gearing.

TABLE XII.—DIMENSIONS OF GEARING FOR CATTLE MILLS.

Size of Mill Rollers.		Roller Pinions.				Bevel Wheels.					Bevel Pinions.					Thickness of Mill Cheeks over Strips.	Cr. to Cr. of Mill cheeks.	No. of Arms on Cattle Cross.
Dia.	Length	Dia. of Pinion.	No. of Teeth.	Pitch	Breadth	Dia.	No. of Teeth.	Pitch	Breadth of Teeth.	Bore of Boss.	Dia.	No. of Teeth.	Pitch	Breadth of Teeth	Bore			
in.	in.	in.		in.	in.	ft. in.		in	in.	in.	ft. in.		in.	in.	in.	in.	ft. in.	
8	10	8	17	1¼	3	1 6	32	1⅜	3½	3½	0 9	16	1½	3½	2⅝	3	1 4½	1
9	12	9	18	1 5/16	3	1 6 7/16	33	1⅜	3½	3½	1 0 5/16	22	1½	3½	2½	3½	1 8½	2
10	14	10	16	1 3/16	3½	2 2½	47	1½	3½	3½	0 9	16	1½	3½	2½	3⅞	1 10½	2
12	13	12	16	2⅜	4½f	2 6⅛	47	2	4½	4½	1 1½	21ff	2	4½	2⅝	4¼	2 2½	2
14	21	14	18	2 7/16	4½	2 9½	42	2½	6	5½	1 3½	19ff	2½	6⅜	3½	4¾	2 5½	4
16	24	16	13	2½	5	2 9½	42	2½	6	6	1 3½	19ff	2½	6⅜	5⅝	5	2 11	4
18	30	18	19	3	6	3 5	47	2½	7	7	1 9	29ff	2⅞	7	6⅛	6	3 6	4

f=top pinion flanged to points outside. ff=flanged to points on both sides.

In some cases small mills are driven by means of belts, either from a portable engine or from a convenient line of shafting. The gearing is generally arranged on a separate bedplate, placed alongside mill. The pulley transmits its motion through a train of double-geared spur wheels, the larger, or second motion wheel, being keyed on the end of top roller gudgeon. Table XIII. gives the dimensions of the main parts of such mills, the diameter, number of teeth, and pitch of the wheels.

TABLE XIII.—DIMENSIONS OF BELT GEARING FOR SUGAR MILLS.

Size of Rollers.		No. of Revs. of Mill.	Dia. of Driving Pulley.	Width of Pulley.	No. of Revs. of Pull'ys	Gearing.						Roller Pinions.				
							Dia.	No. of Teeth.	Pitch.	Breadth.	Bore.	Dia.	No. of Teeth.	Pitch.	Breadth.	Bore.
Dia.	Length															
in.	in.		in.	in.			ft. in.	in.	in.	in.	in.	in.		in.	in.	in.
—	—	—	—	—	—	1st pinion.	0 7¼	14	1⅜	4½	3	—	—	—	—	—
14	20	6	36	5	140	1st wheel.	2 11 1/16	64	1⅜	4	3⅞	14	18	2 1/16	4½	4½ & 4½
—	—	—	—	—	—	2nd pinion.	0 10⅞	17	2	5½	3½	—	—	—	—	—
—	—	—	—	—	—	2nd wheel.	4 6⅜	86	2	5	4¼	—	—	—	—	—
—	—	—	—	—	—	1st pinion.	0 7 1/16 f	14	1⅜	5½	3½	—	—	—	—	—
15	20	5·5	48	6	144	1st wheel.	2 11 1/16	64	1⅜	5	4	15	18	2⅜	4¾	5½
—	—	—	—	—	—	2nd pinion.	0 9	15	2	6	4	—	—	—	—	—
—	—	—	—	—	—	2nd wheel.	4 6¾	86	2	5½	5½	—	—	—	—	—
—	—	—	—	—	—	1st pinion.	0 7 1/16	14	1⅜	5½	3⅜	—	—	—	—	—
16	24	5	48	9	134	1st wheel.	2 11 1/16	64	1½	5	4⅜	16	18	2 1/16	5	5½ & 5½
—	—	—	—	—	—	2nd pinion.	0 10⅞	17	2	6½	4⅜	—	—	—	—	—
—	—	—	—	—	—	2nd wheel.	5 3⅞	100	2	6	5⅛	—	—	—	—	—
—	—	—	—	—	—	1st pinion.	0 8⅜	13	2	6½	3⅜	—	—	—	—	—
18	30	4·5	48	12	114	1st wheel.	3 0½	57	2	6	4½	18	19	3	6	6½ & 6⅜
—	—	—	—	—	—	2nd pinion.	1 0½	16	2½	7½	4¼	—	—	—	—	—
—	—	—	—	—	—	2nd wheel.	6 1½	52	2½	7	6⅞	—	—	—	—	—

f=flanged to points on both sides. 2nd motion wheel keyed on top roller gudgeon.

In some cases small mills are driven by means of belts, either from a portable engine or from a convenient line of shafting. The gearing is generally arranged on a separate bedplate, placed alongside mill. The pulley transmits its motion through a train of double-geared spur wheels, the larger, or second motion wheel, being keyed on the end of top roller gudgeon. Table XIII.

attached, but it was supposed that the feed-water left the heater about 215°.

By means of an automatic pump-governor the condensed water is kept at an even height in the hot well, and a surface blow is attached to remove oil, scum, etc. There is also a bottom blow to remove any sediment which may collect.

Since this particular piece of work was constructed we have usually used eliminators in the exhaust pipe near the engines with good results, and also recommend separators where the steam supply to the engine is long.

To Recapitulate.—The main points to cover in an exhaust-heating system are, first, ample supply of steam to the engines, proper area in exhaust pipe, which should also be as short as may be practical, and connect the same to an expansion tank of ample area; large distributing mains from expansion tank to the buildings to be warmed, and the radiating surfaces for factory use to be of 1in. pipe, although any radiator may be used; and many times indirect radiators form an important feature, as in the case before us the offices were warmed by indirect radiators, and the fresh air forced in by a wheel driven by a water motor.

Dry kilns are always connected to the exhaust system where they are required, and always with good results, although a little more radiating surface is required with exhaust steam than with live steam.

With these results before us no heating engineer or owner should allow the results of 85 per cent. of the fuel consumed to go to waste when it can usually be utilised in the buildings adjoining at least eight months in the year in our Northern States, where the larger part of the steam power developed in this country is used.

The Utilisation of Exhaust Steam.

(*Concluded from page* 84.)

Results.—500H.P. of boilers were shut off as unnecessary, the exhaust steam being sufficient to warm the buildings.

The engines were brought to full speed, thus saving nearly 10 per cent. of all labour connected with the machinery. It is estimated that some 14,000dols. per annum was saved in fuel.

It was found after taking a series of cards that the initial was increased 5lb., and the back pressure reduced 2lb. on a piston area of 900 sq. in., thus adding to the force exerted constantly on the piston 6300lb. The effect was to increase their speed nearly 10 per cent., as there were two engines which developed 44H.P. and the other 27H.P. more than they did before the changes were made.

The steam circulated to all parts of the apparatus at less than 1lb. pressure at the expansion tank, and warmed the buildings all that was desired, although they were in some instances about a quarter of a mile from the expansion tank in different directions.

Tests were made in extreme cold weather, when it was found that all the buildings were warmed thoroughly with a pressure at the expansion tank of less than ¼lb. to the sq. in., the condensed water returning to the hot well at 206° to 208°; at this point it is handled by steam pumps which are regulated automatically by the condense water and pumped through the heater, and from the heater through a purifier to the boiler.

It is not known how many degrees of heat were added in putting the water through the heater, as no thermometer was

Electrical Traction on Railways.*

Want of knowledge regarding high-tension currents, their application and transmission, has been the cause of the delay in the development of electrical traction. A body in motion must either carry with it the energy producing that motion, or have it supplied from an external source during motion. Electrical machines with a high-tension current have a far higher efficiency than locomotives, allowing 10 to 17 per cent. loss in transmission, and may turn from 63 to 70 per cent. of the energy into work. Further, at high speeds, electrical traction is much more efficient than locomotive traction—*e.g.*, to drive a train at a speed of 50 miles per hour up a gradient of 1 in 200 with electrical traction requires only half the energy that it does with locomotive traction.

The heat in a given quantity of coal in a stationary engine can be much better utilised than in a locomotive, due to the greater expansion of the steam, its condensation, and lower temperature of the escaping funnel gases; the former requiring 1·76lb. of coal per indicated horse-power, and the latter 3·3lb. per indicated horse-power. For passenger and express trains with a speed from 30 to 50 miles per hour, the author shows that only 60 per cent. of the energy required for locomotive traction is needed by electrical traction. Therefore, efficiency of electrical traction, as taken from the above figures, is $\frac{1·76}{3·3}\times\frac{60}{63}\times 100=51$ per cent.

The electrical motor has already the rotary motion required for traction, and this obviates the reciprocating action of the locomotive, which limits its speed, and has a deleterious effect on the permanent way. The revolutions of a motor are more nearly constant for largely varying powers, and can, moreover, be kept quite constant by simply altering the magnetic intensity of the fields. The speed of a locomotive falls off considerably as the resistance increases—*e.g.*, if an engine drawing a train of 180 tons on a level road has a speed of 47 miles per hour, then on an incline of 1 in 200 it has only 31·5 miles per hour; of 1 in 150, 25·0 miles per hour; of 1 in 100, 17·0 miles per hour.

This reduces very considerably the average speed of a train, whereas an electric locomotive will not vary more than about 4 per cent. under similar conditions.

The ordinary methods of distribution in vogue for tramways are not applicable directly to railroad traction.

The use of the main rails as conductors is quite out of the question, and if a contact rail is used, it should be so arranged that only that section of the rail in immediate proximity to the train should be traversed by the current, while the remainder is devoid of current. With the high speeds used in railways, contact with a central rail as used in tramways is not practical. The author then describes methods used with great success by himself for transmission of electricity as applied to travelling cranes.

Shunting and making-up trains only partially occupies a number of locomotives which would be dispensed with under electrical traction, and the author describes the methods recommended in making up the trains, speed of shunting, and cost of the installations for the two systems, which result in favour of electrical shunting from the point of view of cost, speed of making up, lighting, etc.

The author then shows the gain of electrical traction over locomotive traction for express service, by supposing a train of 60 tons travelling at 50 miles per hour on a gradient of 1 in 200, which would need 548I.H.P. for locomotive traction and 280I.H.P. for electrical traction, or a gain of 51 per cent.; for a speed of 33 miles per hour, the gain is 69 per cent., or a mean gain of 60 per cent. for an average speed of 42 miles per hour.

£

Cost of loco traction per 1000 miles.....33·7

" electrical traction per 1000 miles....22·4

$$\text{Gain}=\frac{22·4}{33·7}\times 100=66 \text{ per cent.}$$

Taking into account the interest on capital, depreciation, etc., together with the increased frequency of the trains and their greater speed, we have a gain over the present system of $\frac{23·5}{33·7}\times 100=70$ per cent.

The distance apart of the central power stations would be regulated by the strength or tension of the current employed. The capital already expended in locomotives would not be lost, as these could be applied to drive the dynamos at the stations, and fitted with condensers to economise steam, and then replaced by stationary engines as they got worn out. In some districts there would be the saving occasioned by the use of water-power, and also that in general steeper gradients could be employed, and so save prime cost of construction.

The author terminates by advising the construction of an experimental line, or section of a line, for which he gives full details as regards cost, and so forth.

*Inst. C.E.: Foreign Abstracts.

Shipbuilding Notes.

Great Britain is now building 10 armoured ships of war, France 14, Russia 8, United States 9, Spain 5, and Germany 5.

H.M.S. "Crocodile" made a trial of her machinery at Portsmouth on the 22nd ult. With a mean steam pressure of 57lb. the engines developed 2754H.P., and a speed of 13·25 knots was realised.

On the 22nd ult., Messrs. Murdoch and Murray launched from their shipbuilding yard at Port-Glasgow a coasting steamer of 500 tons deadweight. She will be fitted with triple-expansion engines by Messrs. David Rowan and Son, Glasgow.

There was launched, on the 22nd ult., from the shipbuilding yard of Messrs. Scott and Co., Bowling, a screw steamer. The dimensions are:—105ft. by 20ft. by 9½ft. The engines, which are compound surface-condensing, are being supplied by Messrs. Ross and Duncan, Govan.

The Ailsa Shipbuilding Company, Troon, launched, on the 23rd ult., a steel screw steamer. Her dimensions are:—170ft. long by 25ft. beam, and 12ft. depth moulded. The engines are triple-expansion, having 16in., 26in., and 40in. cylinders by 30in. stroke, and are being fitted by Messrs. Dunsmuir and Jackson, of Govan.

Messrs. Earle's Shipbuilding and Engineering Company Limited launched, on the 29th ult., from their yard at Hull, the steamer "Bruno," which they have built to the order of Messrs. Thomas Wilson, Sons and Co. Limited, of the same town. The dimensions are:—Length, 232ft.; beam, 30ft.; depth to top of floors, 15·6ft.

On the 22nd ult., Messrs. Richardson, Duck and Co. launched from their yard at Stockton, a steel screw steamer of the following dimensions:—Length over all, 317ft. 3in.; breadth, extreme, 41ft.; depth, moulded, 23ft. 7in.; tonnage, gross, about 2920 tons. The triple-expansion engines, by Messrs. Blair and Co., are of 200N.H.P., with two single-ended boilers, having a working pressure of 160lb.

On the 22nd ult., Messrs. Wm. Gray and Co. Limited, West Hartlepool, launched a steel screw steamer. Her dimensions are:—Length over all, 300ft.; breadth, 38ft. 10in.; and depth, 22ft. 10in. The builders supply triple-expansion engines, having cylinders 22, 35, and 59in. diameter, with a 39in. piston stroke, and two steel boilers to work at 160lb. pressure per square inch.

Messrs. W. B. Thompson and Co. Limited, Dundee, launched, on the 24th ult., a large steel sailing vessel. The dimensions are:—Length, 317ft.; breadth of beam, 45ft.; and depth of hold, 23ft. She is about 2900 tons gross register, and will carry 4700 tons deadweight; and in the jute trade, for which the ship has been specially adapted, she will hold about 22,000 bales.

Messrs. Wm. Gray and Co. Limited, launched, on the 25th ult., a large steel screw steamer. Her dimensions are:—Length over all, 397ft.; breadth, 48·6ft.; depth, 31·6ft. Triple-expansion engines are being supplied by the builders. The cylinders are 27½in., 43½in., and 73in. diameter, with a piston stroke of 48in. The boilers are of the double-ended type, and are designed for a working pressure of 160lb. per sq. in.

Messrs. Sir Raylton Dixon and Co. launched from their Cleveland Dockyard, on the 27th ult., a spar-decked steel steamer. The principal dimensions are:—Length over all, 327ft.; beam, 41ft.; depth moulded, 29ft.; and she has a deadweight carrying capacity of over 4500 tons. The engines will be fitted by Messrs. Thos. Richardson and Sons, of Hartlepool, the sizes being 24in., 38in., and 64in. by 42in. stroke.

The British Association.

(*Concluded from page* 80.)

I HAVE spoken of the growth of a demand for power distributed in a convenient form in towns. The power distribution in London, Manchester, Birmingham, and Liverpool by pressure water, and that by compressed air in Paris, shows how rapidly, when power is available, a demand for it arises. A striking instance may be found in the small town of Geneva. In 1871, soon after the completion of the earlier system of low-pressure water supply, Colonel Turrettini applied to the Municipal Council to place a pressure engine on the town mains for driving the factory of the Society for Manufacturing Physical Instruments. The plan proved so convenient that nine years after, in 1880, there were in Geneva 111 water motors supplied from the low-pressure mains, using 34,000,000 cubic feet of water annually, and paying to the municipality nearly £2000 a year. The cost of the power was not low. It was charged at a rate equivalent to from £36 to £43 per horse-power per year of 3000 working hours. But even the high price did not prevent the use of power so conveniently obtainable. Since then a high-pressure water service has been established, the water being pumped by turbines in the Rhone. From this high-pressure service power is supplied more cheaply. On the high-pressure system the cost of the power is about 0·7d. per horse-power hour, or £8 per horse-power for 3000 working hours. In 1889 the annual income from water sold for power purposes on the low-pressure system was £2085, and on the high-pressure system £4500. On the high-pressure system the receipts in 1889 were increasing at the rate of £880 per year. In 1889 the motive power distributed on the high-pressure system alone amounted to 1,500,000H.P. hours, there being 79 motors of an aggregate working power of 1279 horses. In Zurich there is a quite similar system, and power, amounting to 9,000,000H.P. hours in the year, distributed hydraulically to various consumers who pay a rental of £1200 per annum. It will be noted that all this power in Geneva and Zurich is obtained from water which has been pumped, and it is the low cost of the water-power which does the pumping which makes this possible. But further, in both Geneva and Zurich the whole of the dynamos supplying electric light are also driven by turbines using pumped water. The convenience of this arises in this way. The fall obtainable in the river in both cases is a small one, and varies. Large turbines are required, and these cannot work at a constant speed. Further, it is expensive to use these large low-pressure turbines to drive directly dynamos which only work with a considerable load for a short portion of the day. The low-pressure turbines in the river are therefore used to pump water to a high-level reservoir, and they work with a constant load all the 24 hours. From the high-level reservoir water is taken as power is required to drive the dynamos, and the turbines driving the dynamos are small high-pressure turbines, working always on a constant fall at a regular speed, and easily adjusted by a governor to a varying load. The system seems a roundabout one, but it is perfectly rational, effective, and economical.

Few persons can have seen Niagara Falls without reflecting on the enormous energy which is there continuously expended, and for any useful purpose wasted. The exceptional constancy of the volume of flow, the invariability of the levels, the depths of the plunge over the escarpment, the solid character of the rocks, all mark out Niagara as an ideally perfect water-power station; while, on the other hand, the remarkable facilities of transport, both by steam navigation on the lakes and by four systems of railway, afford commercial advantages of the highest importance. From a catchment basin of 240,000 square miles, an area greater than that of France, a volume of water amounting to 265,000 cubic feet per second descends from Lake Erie to Lake Ontario, a vertical distance of 326ft., in 37½ miles. Supposing the whole stream could be utilised, it would supply 7,000,000H.P. This is more than double the total steam and water-power at present employed in manufacturing industry in the United States. Immediately below the falls the river bends at right angles, and flows through a narrow gorge. The town of Niagara Falls on the American side occupies the table land in this angle. The earliest traders who settled near the falls erected steam mills in the upper river in 1725 for preparing timber. Later, the Porter family erected factories on the islands in the rapids above the falls. It was not, however, till about 30 years ago that any systematic attempt was made to utilise part of the water-power of the falls. Then a canal was constructed from Port Day, about three-quarters of a mile above the falls, to a fore-bay or head-race on the cliff overlooking the lower river. In 1874 the Cataract Mill was established, taking power from this canal, and other mills were gradually erected till about 6000H.P. was utilised. These mills have been exceedingly prosperous; but since the growth of a feeling against the disfigurement of the falls it has become impossible to extend works of the same kind. The idea of a method of utilising the falls capable of greater development, and free from the objections to the hydraulic canal with mills discharging tail water on the face of the cliff, is due to the late Mr. Thomas Evershed, division engineer of the New York State canals. He proposed to construct head-race canals on unoccupied land some two miles above the falls. From these the water was to fall through vertical turbine pits into tail-race tunnels, converging into a great main tunnel discharging into the lower river. Apart from an inappreciable diminution of the volume of flow over the falls, this plan avoids any disfigurement of the scenery near the falls, and permits a head of nearly 200ft. to be made available. It is, however, essential to such a plan that work should be undertaken on a very large scale. In 1886 the Niagara Falls Company was incorporated, and obtained options over a considerable area of land extending from Port Day for two miles along the Niagara River. In 1889 the Cataract Construction Company was formed to mature and carry out the constructional works required. The present plans contemplate the utilisation of 100,000 effective horse-power. The principal work of construction is a great tunnel 7250ft. long, which is to form a tail-race to the turbines, starting from land belonging to the company, and discharging into the lower river. The tunnel is 19ft. by 21ft., or 286sq. ft. in area, inside a brickwork lining 16in. thick. The base of the tunnel is 205ft. below the sill of the head gate, and permits a fall of 140ft. to be rendered available at the turbines. The brickwork of the tunnel is lined for 200ft. from the mouth with cast-iron plates. The tunnel has been excavated with remarkable rapidity with the aid of drills worked by compressed air. The main head-race, about 200ft. wide, will run for about 5000ft. parallel with the river, having entrances from the river at both ends. Near the lower reach the Soo Paper Company is already arranging to utilise 6000H.P., discharging the water from the turbines through a lateral tunnel into the main tunnel. Near this lower reach will also be placed two principal power stations, from which power will be distributed, either electrically or otherwise in ways not yet fully determined. The first turbines to be erected in these power stations will be twin turbines of the outward-flow type of 5000 effective horse-power. These turbines have a vertical shaft for driving dynamos or other machinery placed above ground. According to Mr. Evershed's original plans it was intended to distribute water by surface canals to different power users, each of whom would sink his own turbine pits, connected below by lateral tunnels to the main discharge tunnel. Some of the power at Niagara will undoubtedly be used in this way, and in the case of industries requiring a large amount of power it will be economical to purchase a site and water rights. Such a plan is, however, not adapted to smaller factories. Obviously for them it would be more economical to develop the power in one or more central stations by turbines of large size under common management. Further, once given the means of distributing power instead of water, an important extension of the project becomes possible. Besides supplying power to industries which may locate themselves at Niagara, the power may be transmitted to the existing factories in Buffalo and Tonawanda. Arrangements are already proceeding to transmit 3000H.P. to Buffalo, a distance of 18 miles, to work an electric lighting station.

In 1890, Mr. Adams, the president of the Niagara Construction Company, visited Europe to examine systems of power distribution. It was in consequence of this visit that the important modification of the plans of the company involved in the substitution, to a large extent, of a system of power distribution for a system of water distribution came to be adopted. The American engineers were anxious to obtain the best European advice as to the methods best suited to the local conditions. A commission was formed, consisting of Lord Kelvin, Dr. Coleman Sellers, Professor Mascart, and Colonel Turrettini, and an invitation was given to engineers and engineering firms in Europe and America to send in competitive projects for the utilisation of the power at Niagara and its distribution to different consumers at Niagara and in Buffalo by electrical or other means. Many of the plans sent in were worked out with great care and completeness. As to the hydraulic part of the projects there was some approach to general consent as to the arrangements to be adopted, but as to the methods of distributing the power there was an extraordinary diversity. Generally the commission reported in favour of electrical distribution, with perhaps a partial use of compressed air as an auxiliary method. Generally, also, they reported in favour of methods of distribution by continuous currents in preference to alternating currents. Since the date at which the commission reported, the Frankfort-Lauffen experiment has been made, and in the opinion of some electrical engineers a distinct advance has been achieved in the use of alternating currents at high potential. The company has not yet decided to adopt any plan for the central stations except in a tentative way. One or more turbines of 5000H.P. are to be erected, and probably at first this power will be distributed to Buffalo by an alternating-current system. The cost of a steam horse-power at Buffalo is reckoned at 35dols. per annum. I believe the company will be able to deliver power at from 10dols. for large amounts and a greater price for small amounts, this price being reckoned for 24-hour days. The new industry of electric lighting has made necessary the provision of large amounts of motive power. Electric traction similarly depends on the supply of motive power. New chemical and metallurgical processes are being introduced which entirely depend for their commercial success on the supply of motive power at a low price. Niagara is likely to become not only a seat of large manufacturing operations of familiar types, but also the home of important new industries.

Tungsten Steel.

"MUSHET'S SPECIAL" has been in the market for so many years that it is probable there are but few users of tool steel who are not familiar with its peculiar qualities. The majority, however, are not aware that it owes its property of becoming and remaining hard when cold, without the necessity for any hardening process, to the fact that it is an alloy of tungsten and ordinary carbon steel. Its extreme strength and hardness are due, principally, to the large percentage of tungsten which it is possible to incorporate as a perfect alloy.

One of the chief advantages of its use for tools is that should they be heated by friction, as is so often the case, either in grinding or cutting, it does not impair their hardness in the least, whereas a tool of ordinary carbon steel would, under the same conditions, require to go to the tool dresser for rehardening. In all other respects there are many brands of steel tools which are fully equal to the Mushet.

It is not for tool purposes alone, however, says the "Iron Age," that this property of tungsten is valuable. Its cost is low enough to admit of its use with the lower grades of steel, and the degree of hardness can be graduated to suit any desired purpose from the very hardest to the lowest temper. The requisite percentage of tungsten necessary to give the required temper can be calculated as accurately as can the carbon for ordinary steel. As an example of the lowest temper, that of a hot coiled spiral car spring may be cited. By careful comparative tests with a carbon steel spring, made of precisely the same mixture as the other, but without the tungsten, its carrying capacity was about 20 per cent. greater, while its resilience or resistance to permanent set was about the same. After testing it was placed in the tempering furnace used for the ordinary springs, and after heating to full red heat was left in the furnace and allowed to cool with the latter. A more perfect annealing process could hardly be devised, as it required about thirty-six hours to cool it sufficiently to handle. It was then retested, and, strange to say, showed an increased carrying capacity of about 5 per cent., and no further permanent set. Samples of the same steel, but with varying percentages of tungsten, were tried for different purposes, and were in all cases satisfactory. A chipping chisel was forged from it, and heated to full red after dressing and grinding. After cooling naturally it was tested on cast and wrought iron, steel, and brass, and stood the roughest possible usage without injury. While these various tests were eminently successful they were barren of practical results, as the company in whose interest they were made discontinued business shortly after. As the difficulties of its manufacture are no greater than we experienced in ordinary steel making, and the cost of tungsten oxide being within the commercial limit, it seems rather remarkable that the use of this alloy should be confined to the one purpose met by the Mushet brand.

Trade Notes.

Messrs. Fowler and Co., of Leeds, have added an electrical department to their works.

Messrs. Walker and Co., of London, are constructing a gas receiver for the Newport Town Council.

The directors of the Sheepbridge Coal and Iron Company announce a dividend for the past year at the rate of 5 per cent.

It has been decided to spend £900 in laying down electric-lighting plant at the new sewage works at Deighton, near Huddersfield.

Messrs. A. and J. Stewart and Clydesdale Co., Glasgow, have received an order for 200 boiler tubes from the Minister of Marine, Italy.

Mr. Ernest Vogel has purchased the business of Messrs. Campbell, Smart and Co., engineers and machine tool makers, Glasgow.

Messrs. Campbell and Calderwood, Paisley, have received two large contracts for the construction of sugar machinery for the East Indies.

Messrs. Dorman, Long and Co. Limited, of Middlesbrough, are supplying the steel girders for the abattoirs belonging to the Glasgow Corporation.

Messrs. Easton and Anderson, of Erith, have secured the contract for supplying the engines for the arc-lighting plant of the Glasgow Corporation.

Messrs. Gimson and Co., Vulcan Works, Leicester, are supplying the iron work required for the Midland Railway station now being erected in that town.

Two turbines of 5000H.P. have been ordered for the Niagara transmission plant from Messrs. Foesch and Ficcard, water-power engineers, Geneva.

Messrs. Trackson Brothers, electrical engineers, of Brisbane, Australia, have recently completed the erection of an electric-light and power plant at Bingera.

Messrs. Crossley Brothers Limited, Openshaw, are making three 25H.P. "Otto" gas engines for the Wholesale Co-operative Society, Newcastle-on-Tyne.

The Electric Launch and Navigation Company, of New York, have secured the contract for a fleet of 40 electric launches for use at the Chicago Exhibition.

Messrs. Cathcart, Peto and Radford, London, have just completed an installation of the electric light in Messrs. C. Brown and Co.'s Steam Flour Mills, Waddon, Croydon.

Messrs. Derry and Sons, of Westminster, London, have received an order to supply the whole of the heating apparatus required for the Lambeth Infirmary. The amount of the contract is £6300.

Messrs. Goddard, Massey and Warner, of Nottingham, have been awarded the contract for the supply of the sludge-pressing machinery, etc., required by the Glasgow Police Commissioners.

The Indiarubber, Gutta-percha, and Telegraph Works, of Silvertown, London, have received an order from the Egyptian Department of Railways for 2 miles of cables and 500kilos. of soft galvanised iron wire.

The directors of Alldays and Onion's Pneumatic Engineering Company, Birmingham, have declared an interim dividend on the ordinary shares, for the half-year ended June 30, at the rate of 10 per cent. per annum.

Mr. Willoughby Warden, of the firm of Morris, Warden and Co., 60, Robertson-street, Glasgow, having resigned Messrs. J. and H. Gwynne's agency, has been appointed representative for Scotland and Belfast by Messrs. G. E. Belliss and Co., of Birmingham.

The Middleton Ironworks at West Hartlepool, which were formerly carried on as iron rolling mills by Messrs. George Bower and Co., London, but have been idle for many years, have been purchased by a syndicate of West Hartlepool capitalists, and will shortly be reopened.

The directors of Messrs. Bolckow, Vaughan and Co. Limited announce that, owing to the depression in trade and to the interruption of the company's operations consequent on the strike of the Durham colliers, they are unable to sanction the payment of an interim dividend in respect of the half-year ended June 30 last.

Wheel cutter in metal only. Every description of gearing. R. CHIDLAW, 43, City-road, Manchester.

Having regard to the enormous circulation of THE MECHANICAL WORLD, the Editor suggests that it is by far the best medium for the insertion of every kind of "Wanted" advertisement, and the price is only one half-penny per word. The Editor will be glad if MECHANICAL WORLD readers will kindly bear this in mind as occasion arises.

Standard Six-wheel Locomotive: Baltimore and Ohio Railroad.

THE six-wheeled locomotive shown in the illustration herewith, from the "Railroad Gazette," is one of the new standards of the Baltimore and Ohio Railroad. The following are the general dimensions :—

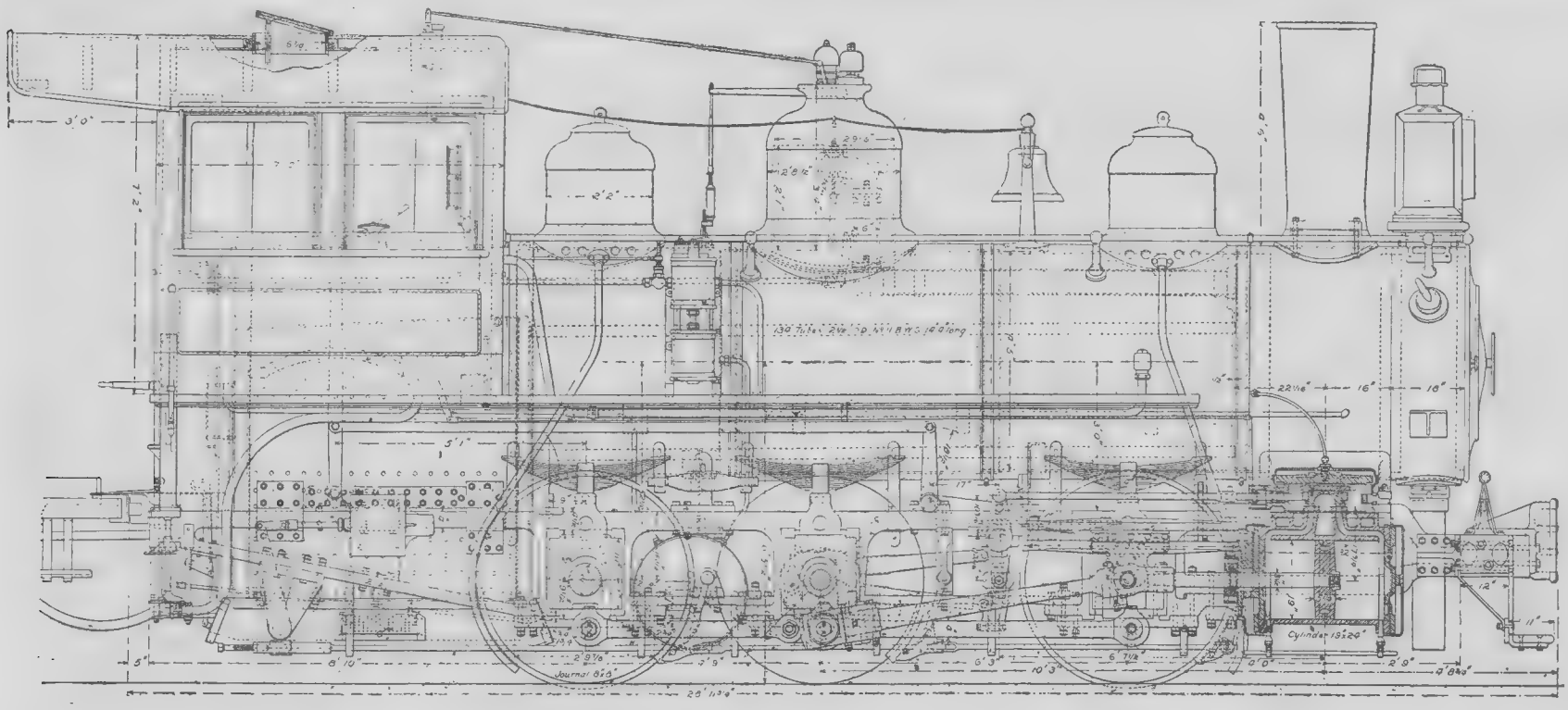
Cylinders.—19in. × 24in.
Pistons.—Solid. with cast-iron steam packing.
Valves.—Richardson balanced, ¾in. outside, ½in. inside lap.
Drivers.—50in. diameter.
Weight on drivers.—100,600lb.
Tyres.—Four flanged, 5½in. wide; two plain, 7in. wide.
Driving and total wheel base.—11ft.
Boiler.—53in. outside, straight top, sheets ½in. steel, steam pressure 165lb.
Tubes.—144, 2¼in., O.D. 14ft. 4in long.
Firebox.—72in. deep, 34½in. wide at bottom, 43in. at top, 67⅞in. high in front, 61⅝in. back.
Radial stays.—1in. diameter.
Water space.—3in. side and back, 4in. front.
Driver brakes.—American.
Tender brakes.—Westinghouse.
Tender.—4-wheel centre-bearing trucks; wheels, 33in. diameter; steel axles with standard journals, 3¾×7in.; sloping tank, 2100 gallons capacity.

Among the admirable details of construction is the method of holding the coupling rods on the front pins. The pin is turned out to receive the washer, which is counterbored to receive the head of the bolt. The bolt passes entirely through the pin. The pin is bored out at the back to take the nut of the bolt, which is screwed up by a socket wrench. The nut is held by a cotter. This makes a close, compact, and neat arrangement for a front pin. The side rods have rectangular sections and solid ends. A 1¼in. wrought-iron bushing is inserted in the ends of the rods into which the cup is then screwed. This bushing acts as a retaining pin for the brass bushings.

The cab is of a very neat design, having rounded corners, and covered with ⅛in. iron on the front and sides. The roof is covered with No. 27 B.W.G. galvanised iron. Doors are placed both front and back, making the cab entirely enclosed. A ventilating trap is placed in the roof, and ventilating dampers are placed beneath each front door.

The Breakage of Winding Ropes in Mines.

SINCE 1884 there has been a law in Saxony that all breakages of winding ropes and chains shall be reported to the mine inspectors, and the consequence has been a diminution in the number of accidents of this nature from 28 in 1884 to 11 in 1890. In order to fully appreciate the improvement that has taken place, two other facts should also be taken into account—viz., that during these seven years the output has grown considerably, and the depth to which the mines are worked has increased. Of the 133 breakages which occurred during these seven years, 1884—1890, only 18 were on the down journey and the remainder on the up journey. It was not possible to ascertain the cause of all the accidents, but 43 were found to be due to bad or worn-out material, from 5 to 7 to imperfect welding, 20 to excessive friction on the pulleys, and 20 to the jamming of the cage in the shaft. The mine managers in that country are not agreed on the question as to whether it is best to trust to the uniformly good quality of the rope and machinery or to adopt some form of safety catch. In the collieries where such a precaution has been adopted the services of the apparatus were called upon 79 times, and in 60 cases it saved the cage from falling. Though the efficiency of the safety catch is by no means as perfect as might be desired, still the results that have been obtained are so far satisfactory that its general adoption may be recommended. It would be considered a poor form of safety cage which would not act over 60 times in 79 in this country, and miners would soon protest against its use. Our Continental friends are slow to adopt our improved appliances.



STANDARD SIX-WHEEL LOCOMOTIVE : BALTIMORE AND OHIO RAILROAD.

Testing and Analysis of Iron and Steel.—XI.

BY MESSRS. LEADBEATER AND HODGSON (*Analytical Chemists*).

[ALL RIGHTS RESERVED.]

A GOOD form of gas combustion furnace is shown in section Fig. 31. The number of burners it contains may range from 12 to 24 and upwards, according to the purposes for which it is intended; but if it is only required for iron and steel analysis, one with 14 or 16 burners will answer admirably. The combustion tube is shown in section at C. It rests on little fireclay supports arranged all along its length, or occasionally it is laid in a thin fireclay semi-circular trough before being placed upon the supports.

The latter protects the tube better when it is raised to a red heat. The fireclay covers B serve to prevent radiation of heat, and deflect the flame downwards on to the tube. They are supported by the V grooves attached to the clamp screws A, by means of which they can be raised or lowered to suit various sized tubes. When the combustion is over, or when it is necessary to examine the tube at any stage of the operation, the covers are allowed to fall back and rest on the bars H placed along each side.

The various Bunsen burners, each of which can be regulated independently, are attached to a long tube which runs the entire length of the furnace, and which may be raised or lowered by means of the clamp F, in order to bring the burners nearer to or farther off the tube as required.

Where combustions are only made occasionally, a very good furnace may be extemporised from a few fireclay strips, and burners with tubes elongated at the top. These can be readily obtained at any dealer's (see Fig. 32). They are dropped into the top of an ordinary burner, and if two or three are placed together a long tube can be accommodated.

The fireclay strips are supported on two or more retort stands, and the combustion tube rests upon short pieces of pipe stem, the burners being placed underneath. If properly constructed this furnace answers admirably, and it has the advantage of being cheap and readily obtainable.

Other forms of furnaces constructed for burning charcoal, etc., instead of gas, may be obtained, but they are very inconvenient and are seldom used.

The whole of the apparatus being collected together, the work may be proceeded with.

When inserting the plugs of ignited asbestos in the tube, a hole should be pierced through the bottom of the first plug next the one containing the carbon with a finely-drawn-out glass tube or wire, in order to allow the gases to pass readily. The ignited copper oxide, which should be about the size of hemp seed, is then placed in position, and finally the outside plug of asbestos, which must also have a small hole pierced through at the top in order to cause the gases to pass through the copper oxide in a diagonal direction.

In filling the potash bulbs with solution, care must be taken not to get them too full. The liquid should just rise in each limb to a point about midway between the bottom and the top bulbs, as otherwise, when the gas commences to flow, a portion of the solution will be forced out of the apparatus. The bulbs F are filled with finely-divided chloride of calcium, which must, however, be free from dust. The object of these bulbs is to absorb any aqueous vapour which might be generated by traces of moisture still remaining in the combustion tube.

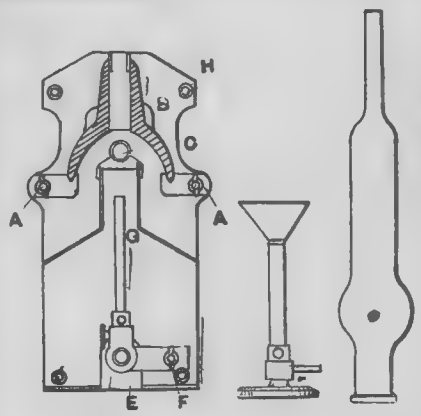


FIG. 31.

FIG. 32.

FIG. 33.

The two bulb tubes G and H require the most careful attention; in these the carbon dioxide (CO_2) generated by the combustion of the carbon upon the asbestos plug is absorbed by strong potash. The potash solution is contained in the bulbs G. The first of the bulbs marked H is filled with little pieces of pumice soaked in a solution of KHO, and dried thoroughly; the second is filled with small lumps of chloride of calcium ($CaCl_2$). The object of this last pair of bulbs is to absorb any moisture which may possibly pass out of the bulbs G. Both G and H are provided with tube stoppers, and with horse-hair hoops to hang them on the hook of the balance during the weighing operation.

Some chemists dispense with the bulbs H, and in place substitute small absorption tubes (Fig. 33), which are directly attached to the bulbs G after the manner of glass stoppers.

A little piece of cotton wool is first dropped in; then a mixture of one-third potash pumice and two-thirds chloride of calcium in small lumps; finally, another piece of cotton wool is inserted in the neck, and the tube is then fitted into its place upon the main bulbs.

This last arrangement is by far the most convenient, as the two bulbs may be weighed together without any trouble.

All the apparatus must be connected most carefully with thick-walled tubing, or otherwise diffusion takes place through the indiarubber, and interferes with the results.

When all is placed in position, the oxygen gasholder is temporarily removed, and the aspirator turned on in order to draw a current of air through the apparatus for a little time. A tube stopper must now be placed on the end of the bulb from which the gasholder has been disconnected, in order to seal it. If water still continues to run from the aspirator, it is evident that there is a leak at some of the joints of the apparatus; they must, therefore, be examined, and the faulty joint made good. If, however, the water stops running, it is a proof that the joints are sound. A little more air is aspirated through the tubes, and then the gasholder may again be connected.

The bulbs G and H are then disconnected, and immediately sealed with their proper tube stoppers. They are then carefully wiped with an old silk handkerchief, and suspended in succession by their horse-hair loops from the hook of the balance, and their weights carefully noted.

They are then replaced in their proper position, the tube stoppers being kept apart, in order that they may again be replaced upon their respective bulbs.

The bulbs containing the liquid potash must be hung in an inclined position in such a manner that the gas ascends as it passes through the three bottom bulbs.

All is now ready for the combustion. The tap of the oxygen gasholder is opened slightly; the aspirator tap having previously been opened, a slow current of oxygen is drawn through the apparatus for a little time.

The burners are now lighted, but turned down very low, in order to gently warm the tube. When this is done, those burners under that portion of the tube containing the copper oxide are gradually turned on full.

When the tube and the copper oxide contained in it are red-hot, the flames under the portion containing the carbon are turned up, and regulated to keep a nice red heat all along the tube.

The fireclay covers are from time to time lifted with a pair of crucible tongs, in order to inspect the tube.

The current of oxygen should be regulated so as to pass from two to three bubbles per second through the potash solution.

(*To be continued.*)

SEVENTY-FIVE per cent. of the students of the City of London College, under Professor Henry Adams, who sat at the last May examination of the Science and Art Department in Machine Construction, obtained first-class certificates, and 12½ per cent. obtained second-class certificates. An increased prize list is announced for the next session, commencing October 1.

Blears' Cutting Tools and Holder.

THE illustrations herewith show a novel form of tool holder, of which Fig. 1 is a perspective view, and Fig. 2 a sectional elevation. The body of the holder A is of square section, and is held in the rest in the usual way. It is bored to receive a

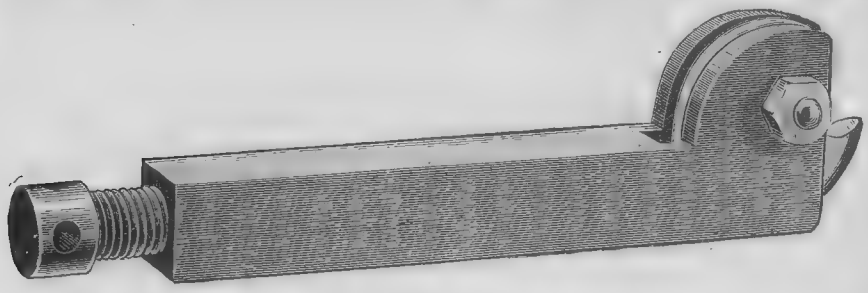


FIG. 1.

rod B, against one end of which a set screw C presses. At the other end of the holder the circular cutter D is carried in the manner shown. The special forms of cutters used are shown in Fig 3, and, as will be seen, consist of circular discs of various sections. These are carried by the bolt E, Fig. 2, and as the cutting edge *d* is ground away, a

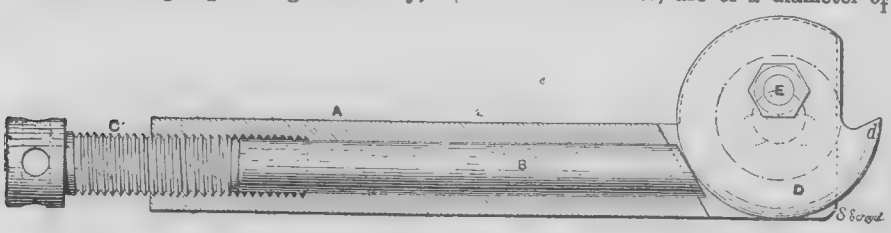


FIG. 2.

slight forward movement of the rod B by the set screw C adjusts the position of the tool as required. Fig. 4 shows a modified arrangement forming an angle tool holder. It is claimed that with this system of cutting tools no smithing or tempering is necessary, and that greater facilities are afforded for the economical use of self-

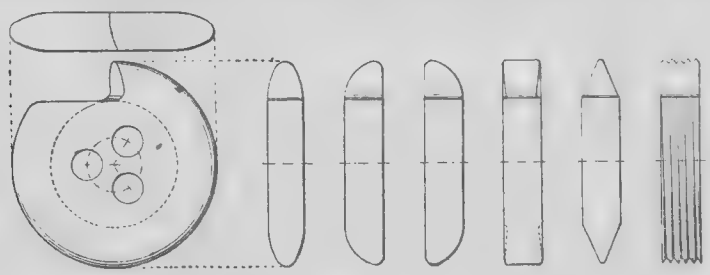


FIG. 3.

hardening steels. Also less grinding of the tool is required, and as it wears the whole of the circumference of the disc can be used by successively employing the three holes as the points of suspension. It is also claimed that no packing of the tool holder in the slide rest is required, and that the tool cannot slip away from the work.

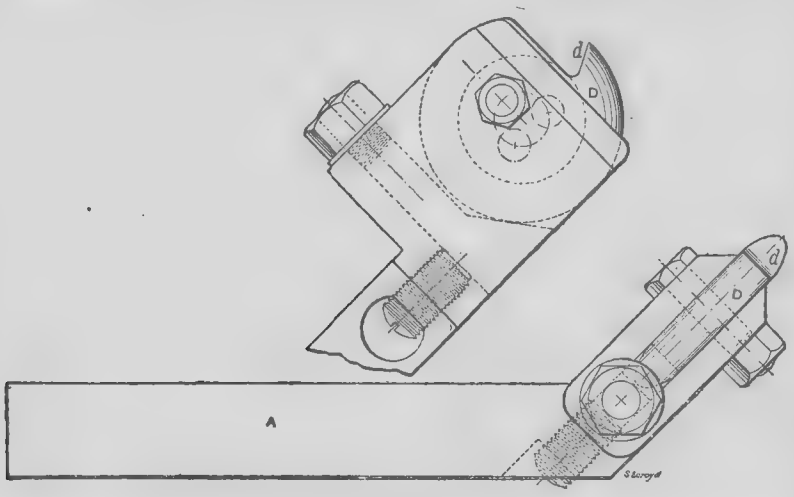


FIG. 4.

These holders can be used equally well in lathes and planing and shaping machines. Further particulars may be had from Mr. T. Blears, 56, Freme-street, Manchester.

AN ingenious clock has been devised in which the motive power is a very small turbine water motor, that is put in connection with the town hydrant, or with any other high-pressure water supply. The quantity of water used is small. Should the clock run down, owing to a long-continued failure of the water supply, this is indicated by means of an electric bell alarm.

Wire Rope Transport.*

THIS article describes a wire ropeway for conveying materials of construction to the site of the fort of Tournoux, near Condamine, in the department of Hautes-Alpes. The difference of level between the two stations is 1525ft., the horizontal distance 2307ft., and the length of the cables 2766ft. The load carried is 10cwt., and ten journeys are made in the hour. The system employed is that of stretching two fixed cables to carry the loads, and to employ an endless cable to haul them. The carrying cables (which are in one span for the whole distance) are of a diameter of 1·2in., and the hauling cable 0·56; they are made with a hemp centre of six strands, having six wires each. A steam engine of 15 H.P. is used. The rope is kept in tension by passing round a sheave on a movable carriage at its upper end. The driving machinery is at the foot. The drum is 6ft. 7in. in diameter, and the rope has only one half-turn on it.

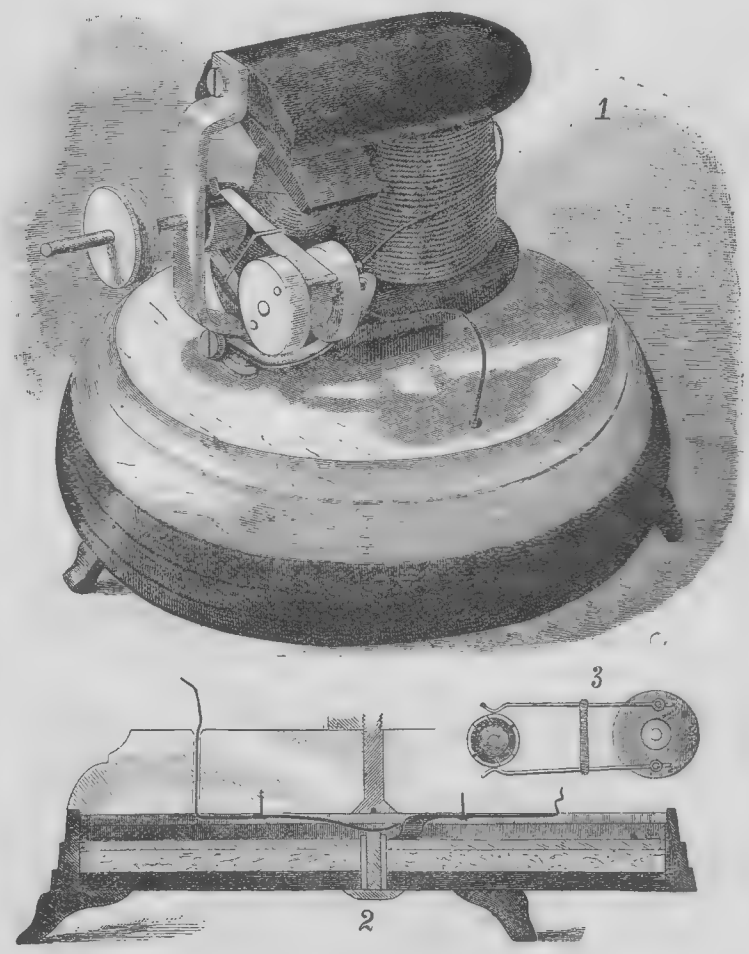
The cost of the whole installation was £1200, and the working expenses and maintenance £1 8s. 2d. per day, to which may be added £2 per day for the purpose of extinguishing the capital outlay. This gives the cost per ton at 1s. 4½d. nearly when 50 tons are carried per day, whereas by carts it would have cost over 6s. 8½d. per ton.

THE new 110-ton gun, to take the place of the defective 110-ton gun in the "Victoria," the flag-ship in the Mediterranean, has been delivered at Chatham Dockyard from the Elswick works, and will be at once despatched to the Mediterranean. It is understood that no further orders will be given by the Government for the manufacture of these large and costly guns.

*Inst. C.E.: Foreign Abstracts.

An Inexpensive Electro-motor.

POSSIBLY some of our readers will be interested in the following description of a small and inexpensive electro-motor, taken from an American contemporary:—In the motor shown in Fig. 1, the field magnet consists of a pair of polar projections formed integrally with the magnet core and a single bobbin formed of 27ft. No. 18 wire, A.M.W.G., wound on the core. The armature, which is of the Siemens H type, is 1½in. in diameter, and the end pieces or polar extremities are ⅝in. wide and ⅞in. long. The portions on opposite sides of the armature shaft which receive the armature winding are $\frac{11}{32}$in. in diameter and $\frac{7}{16}$in. long. The winding of the armature consists of 15ft. of No. 22 wire, which is wound on the core after the manner of a straight electro-magnet, and the extremities of the wire are connected with a two-part commutator mounted on the armature shaft. The commutator is formed of a cylindrical wooden core, with two semi-circular pieces of copper attached to opposite sides thereof by clips projecting from the edges of the copper pieces and bent into the concaved ends of the wooden core. The commutator brushes consist of two copper springs looped at their outer ends and pivoted on wires running through



AN INEXPENSIVE ELECTRO-MOTOR.

the spool, the springs being pressed toward each other and into contact with the commutator cylinder by a rubber band surrounding both of the springs.

The battery in the base of the motor consists of a copper pan provided with a central rivet extending upwardly and surrounded by a piece of rubber tubing, a piece of thick loose felt and a zinc disc resting upon the felt, but out of contact with the pan and central rivet. To the bottom of the wooden base which forms the cover of the battery are attached two copper springs, one of which rests upon the zinc plate and the other upon the end of the rivet, thus establishing an electric connection between the two poles of the battery. One of these springs is connected with one terminal of the field magnet, the other terminal of which is connected with one of the pivotal wires of the commutator spring. The other pivotal wire is connected with the other spring. The battery is charged by placing under the felt some powdered sulphate of copper and upon the top of the felt a little sulphate of zinc, then filling the cell up with water so as to immerse the zinc. The battery thus charged is sufficient to run the motor for two or three hours. The motor, however, is capable of withstanding the current of a much larger battery, and if connected with such a battery it might do a considerable amount of useful work.

The Manchester Association of Engineering Students.

THIS association has just brought to a close a very successful summer excursion season by the following visits:—

On Wednesday, August 17, a party of about 40 members visited the "Grinnell" Sprinkler Works, Blackfriars Bridge, Manchester (by kind permission of Messrs. Dowson, Taylor and Co. Limited). Mr. A. Hilton met the students at the works, and immediately conducted them to watch the actual production of "Grinnell" sprinklers from the castings through the 52 different processes, every one of which is executed on the premises. One of the sprinklers made was fixed to a test pump, and a pressure of over 800lb. per sq. in. was put upon it, but no effect was obtained on the sprinkler. It was then disconnected from the pump and placed in a bath of warm water, and the temperature gradually raised to 130°F., when the levers of the sprinkler fell away, thus showing the extreme sensitiveness to heat when internal pressure had no effect. Opened sprinklers were fixed to a water main in the yard, and when the valve was opened a perfect shower was distributed at once, covering a circle of 30ft. diameter. Various chemical fire engines were tested, the first one being the No. 5 Simplex, in which, on breaking the acid inserted inside, a pressure on the gauge of 120lb. per sq. in. was immediately raised and water discharged 17yds. into the open air, the smaller sizes giving similar results. An actual fire was kindled in the works, and in 30 seconds the sprinklers fixed at the ceiling for the protection of the works came into operation, and at once began to subdue, and finally extinguished the fire. An interesting experiment was also made with Dowson and Taylor's patent differential air valve, where a smaller pressure of air in the pipes can hold back a higher pressure of water in the mains.

On Saturday morning last, by the kindness and courtesy of Messrs. Laird Brothers, 30 members of the association visited the Birkenhead Ironworks, Birkenhead.

These works were founded in 1824 by William Laird, the father of the late John Laird, M.P., and since that date there have been built here, including work now in hand, 593 vessels, having an aggregate tonnage of over 380,000 tons, and an aggregate of over 358,000 I.H.P. A large portion of this work has been done for the British and Foreign and Colonial Governments. Many famous and [illegible] vessels of the mercantile marine have likewise been constructed here. [illegible] attention has been given to the [illegible] and construction of steamers for river navigation, some of which were the pioneers in opening [illegible]

form important channels of commerce. Among these steamers is included the "John Randolph," the first iron steamer ever seen on American waters. Among the notable ships recently turned out are the twin-screw Atlantic liner "Columbia," built for the Hamburg-American Steam Packet Company, one of the fastest and most successful ships in the Atlantic trade, and the Chilian torpedo gunboats, "Almirante Lynch" and "Almirante Condell," which have recently distinguished themselves in several naval engagements on the coast, notably that which resulted in the sinking of the ironclad "Blanco Encalada."

Entering the works from the office, the model-room is on the right. Adjoining is the large engine-shop, with a variety of work, and close by are shipbuilding tools and a frame-bending furnace.

The two southernmost slips are occupied by H.M. ships "Onyx" and "Renard," twin-screw torpedo gunboats: length, 230ft. by 27ft. beam, and 14½ft. deep; 735 tons displacement, and 3500I.H.P.

In No. 5 graving dock lies H.M. first-class twin-screw battleship, "Royal Oak": length, 375ft. by 75ft. beam, and 44ft. depth; displacement, 14,300 tons; power, 13,000I.H.P. Between Nos. 4 and 5 docks is a new shop fitted up with shipbuilding machinery specially adapted for the heavy work on this vessel. In the engine-erecting shop there are in course of erection the engines for the "Onyx" and "Renard"; also twin-screw engines of 2500I.H.P. for s.s. "590" and screw engines of 3000I.H.P. for s.s. "589." Near the 50-ton crane on No. 1 slip is "No. 590," a twin-screw mail and passenger steamer for the Barrow and Belfast service of the Barrow Steam Navigation Company, which is 280ft. by 32ft. by 14ft., 1500 tons, 2500I.H.P. In No. 3 dock, under a permanent roof, there is being built a screw steamer, "No. 589," for the Atlantic cattle trade, to be 430ft. by 46ft., 5500 tons, 3000I.H.P. Near here is the smithy; at the north end of the works are the steam saw mills and the joiners' shops, with mould loft, etc. The boiler shop is situated in Beaufort-road, and opposite is Gilbrook Yard, where are the "Libertad" and "Independencia," river ironclads for the Argentine Government, 240ft. by 44ft. by 22ft., carrying two 24-centimetre guns in barbettes, and four 4·7in. and four three-pounder quick-firing guns.

The boiler factory was completed in September, 1888, and has already turned out a large number of boilers, many of which are of exceptional size, some of the largest weighing about 75 tons each.

Notes on a Problem in Water Power.*

In presenting this paper the author introduced the subject by a few remarks, in which he said he had not at first intended it to be presented as a formal paper, but he thought the subject one worthy of discussion, and hoped what he had to say would bring about such discussion. He thought it strange that the subject of impact water wheels had not received more attention. What had been done in the way of development of such wheels had been done experimentally. Many wheels had been sent to California which would not give more than 30 per cent. efficiency, and many more of them not over 50 per cent. His paper, as presented by himself, was as follows:—

The present paper is to be a non-scientific one, and in other respects is not to be classed among the contributions such as are commonly presented before this society. Neither are its objects the same. The purpose is to present some thoughts on a very important subject, with a view to calling out further and more able discussion. There being nothing exact or determinate to deal with, there will be neither figures nor quantities included, so that no severe mental strain need be apprehended in following the remarks.

The subject is water motors, or, as we commonly say, water wheels, for utilising the action of gravity on water, and an inquiry into the probable conditions, inferences, or deductions which have led up to and established modern practice as it now exists in this country.

Water wheels, as we have to deal with them, may be classed as gravity wheels, including (1) overshot breast wheels and, perhaps, the Poncelet types; (2) pressure wheels, including what we call enclosed turbines and reaction wheels; (3) impulse wheels, driven by spouting water.

The classification thus assumed is, for short, gravity, pressure, and impulse wheels. These may be said to cover the various types in common use.

In modern practice the class called pressure turbine wheels constitutes perhaps four-fifths of the whole. These can be divided into three general types—namely, the Fourneyron, or outward radial discharge; the Jonval, or downward discharge parallel to the axis of rotation; and the American, or inward flow wheels. These have come into general use all over the world, and have a literature of surprising completeness. They are by common consent regarded as the most efficient, and indeed until recently have been the only wheels which were considered in connection with an efficiency beyond 60 per cent.

The question to be presented, and the main point in this communication, is, What has produced this particular form of evolution in water-wheel practice, and why has pressure instead of impulse been the principle or mode of operation followed in all countries?

Before attempting any answer to this inquiry, it will be well to further examine or explain in as simple a manner as possible the nature of the class called pressure turbine wheels.

A column of water resting upon the vanes of a turbine wheel, which are free on their reverse side and meet no resistance there, represents complete efficiency less machine friction; and the science of turbines, to so call it, is directed to removing the impeding water and its resistance on the reverse side of the vanes—that is, on the discharge side—after the function of pressure has ceased or has been utilised. It is common to divide the effect of the water or its functions in this class of wheels into gravity, impulse, and reaction; but there is no need of such assumption or introducing the complex nature of these forces thus combined, because the whole is explainable as simple pressure, and all observed phenomena point to this as the "mode of action" in pressure turbines.

I am in this assumption no doubt transgressing upon what are called established data, but the issue is not important to the present subject, and it will be sufficient to call the active force one of pressure alone, and the resistance or loss a result of an imperfect riddance of the water on the reverse or discharge side of the vanes after it has performed its work by pressure, impulse, or otherwise.

Following this method of operating to its constructive features, it involves closed vessels or conduits, not only to the water wheels, as in other cases, but around them. They must be enveloped in the fluid that drives them, and contained in cases strong enough to sustain not only the static head, but also the effect of water concussion, and in most cases afford support for the wheels themselves and their shafts.

The bearings of the wheels have to sustain the weight of the running parts, also in many cases a pressure of the head equal to the area of the issues multiplied into the head. The wheels are submerged, placed at the bottom of the head or near it, inaccessible to observation, and also for repairs, calling for unusual and expensive provision in the way of bearings and other constructive features, including extra strength of all parts. The hydro-dynamic conditions both of entrance and discharge call for complicated forms that cannot with safety be built up, and pressure turbine wheels thus become large and expensive castings, the value of which depends upon the integrity of every part. If a vane be broken or imperfect, the whole wheel is lost. The diameter being limited because of first cost, a limit of rotative speed is reached at heads of 50ft. or so, and even at that head the bearings have to run under undesirable conditions; in other words, this type of wheels does not permit control of rotative speed, that being limited by both first cost and operating conditions.

(*To be continued.*)

* A paper presented by John Richards at the San Francisco meeting of the American Society of Mechanical Engineers.

The Strength of Leather Belting.

In a paper on the "Art of Tanning Leather and Making Belting," which was recently read by Mr. Charles Schieren, at a meeting of the Polytechnic Section of the American Institute at New York, it was shown that the strength of leather taken from various parts of the hide differs greatly in strength. In some tests made the pieces were all 18in. long and 2in. wide. These pieces were taken from different parts of the hide, and were tested with a powerful testing machine until they broke. It was shown that a piece taken from the lower part of the centre withstood before breaking a strain of 2490lb. Another part, cut from the upper part of the centre of the hide, broke at 2000lb. Another piece, taken from the lower part of the shoulder, broke at 1390lb., and a piece cut from the upper part of the shoulder broke at 1130lb. These tests show that the strength of leather varies more than 100 per cent., according to the portion of the hide from which it is taken; and when it is understood that some manufacturers will work up as much of the hide as possible into a belt, engineers can readily account for the unequal stretching of the leather belts which they have used.

A New Form of Windmill for Electrical and other Purposes.†

At the present time the employment of the form of energy known as the electric current to industrial purposes has become very extensive; and, in the near future, its application in that direction is likely to be still further increased. We have already many large private installations of the electric light. Every steamboat of any size is now electrically lit. In many places the current is used for the transmission of power. Already several large towns have adopted it instead of gas for street lighting, and the question of general house-to-house lighting is one whose solution only awaits a slightly greater economy in current production and distribution. It may be said that as yet the current is generated almost exclusively by dynamos driven by steam engines, so that it is merely a transformation of the potential energy of coal, and, so long as this is the case, it is obvious that any cheapening in its production can only arise either from an increase in the efficiency of the dynamo or of steam engine, or of both. Now these machines have attained so great an efficiency that there is scarcely any hope for much improvement in this direction. Primary batteries of several forms have been suggested and tried, but currents got from the oxidation of metals will always, I think, be too dear for practical purposes. Something may be expected from thermo-electric batteries, for here we have the direct transformation of heat into current electricity without the intervention of the wasteful middleman represented by the steam engine and dynamo. This, however, can hardly be said to have reached even the experimental stage.

Considerations such as these have led electrical engineers to look about and see if there may not be some other source of power at present unused, and which might be utilised for current production. Naturally, water power first suggests itself. The Niagara Falls have often been spoken about, and their available energy for that purpose calculated. In several places electric lights are run from waterwheels where the fall happens to be near at hand, but in the great majority of cases the available falls of any size are so far from the centres of population that the cost of conducting the current almost prohibits their use. Much, no doubt, may be done by employing rapidly-alternating currents of high voltage, and so diminishing the cross-section of the necessary leads, but even then, when the distance is considerable, the cost of conduction comes in as a serious item. And, besides, water power is not free. Although a fall may be unused just now, still, when it is proposed to use it, it immediately acquires a money value, and must either be vended or bought outright.

Next, after water power, comes the consideration of wind power; and it is about this that I am principally to speak. The wind is proverbially free, and is to be had everywhere, although it is of a very intermittent nature. Up till recently, this entirely precluded its use for current generation, as it was obviously impossible for it to work electric lights or do any kind of work where a steady current at a fixed time was required. But all this has been changed by the invention of storage cells or accumulators. These are now highly efficient, though a little too expensive; but disregarding the expense, we are now able to stow any quantity of electric energy and get a high return, even although a considerable time elapse between the storing and the using of it. No sooner was the accumulator invented than windmills for electric storage began to be thought of. At the York meeting of the British Association, Sir William Thomson suggested the construction of cheap windmills to run dynamos for charging accumulators, but, so far as I know, no practical trial was made till the summer of 1887, when I erected my first windmill in the village of Marykirk, Kincardineshire. At that time I procured a set of 13 accumulators and constructed a windmill of the old English type, having four arms and canvas sails. The length of the arms was about 14ft., and the sails were 8ft. by 3ft. The mill was provided with bevelled gearing at the top of a vertical shaft, and bevelled gearing below, so arranged that the driving wheel moved always in the same vertical plane, no matter in what direction the wind shaft pointed. The mill was turned into the wind by hand, having no tail or other gearing for keeping automatically head to wind. The dynamo was driven by a belt from the driving wheel, and with this I was able on two or three windy days to store my cells. Although the experiment was not on a very large scale, it was sufficient to show me that accumulators could quite well be charged, when the electrical connections were properly made, by a dynamo driven at the irregular speed characteristic of a windmill. Sails I found were not a great success, especially since I had no way of reefing them. To prevent them being torn to pieces, the mill had to be stopped when the wind was high—that is, just at the time when it should have been going at its best.

I remedied this partially. I altered the wind wheel from the English to the American type, having a number of arms and blades of sheet iron. I also introduced the further improvement of doing away with the driving wheel being always made to go in the same plane. This is absolutely necessary if the windmill is to drive a saw mill, a corn mill, or anything of that sort, but for electrical purposes the dynamo can quite easily be attached to the wind shaft platform so as to turn with the mill as the wind changes. In this way all gearing is avoided, as the dynamo can be driven by ropes from a large wheel keyed directly on to the wind shaft. This I found to answer very well so long as the wind had a moderate speed, but, like all other windmills, I soon found that it had either to be made self-reefing or stopped altogether when a breeze came. This is obviously unsatisfactory, as the best of the wind for storage purposes is lost, and hence this problem presented itself—viz., how to construct a windmill that would satisfy the following requisites: (1) it must always be ready to go; (2) it must go without attendance for lengthened periods; (3) it must go through the wildest gale, and be able to take full advantage of it.

A possible solution of the problem is presented in the Robinson anemometer, which consists of four hemispherical cups attached to four arms, and moving in a horizontal plane about a vertical axis. From the theory of this instrument, which is, however, only approximate, it appears that whatever might be the speed of the wind, the speed of the cups attained a certain terminal value, such that the couple due to the wind pressure was exactly equal to that produced by the resistance to the motion through the air, and the friction on the bearings.

Last summer I erected a machine of this kind, which has been considerably improved within the past three months. The cups are replaced by semi-cylindrical boxes attached to four strong arms, each about 26ft. long. The opening of each box is 10ft. by 6ft., and the vertical shaft is a long rod of iron 5in. in diameter. At the lower end it carries a massive pit wheel, which actuates a train of gearing, and drives a fly-wheel 6ft. in diameter with the requisite speed for driving a dynamo connected with it by a belt in the ordinary way. This machine worked most satisfactorily, and with a fair wind speed gave about 2E.H.P. I also tested it in a strong gale by allowing it to run with no load, and the result was perfectly satisfactory, as a safe terminal speed was attained, and all racing avoided. Hence I think that electrical windmills, at least for small installations, are likely to assume this form, as there is no limit to the size and strength with which they may be constructed, and, if necessary, several could be placed in any well-exposed position, each having its own dynamo and set of accumulators. During the past few months I have increased the power of the machine by adding an auxiliary box to each arm with a gap between it and the previous one. This I find to be better than merely increasing the size of the previous box. As the whole is a case of vortex motion, the theory is very difficult. Information can only be got from models and by applying the principle of dynamical similarity.

Regarding the electrical connections necessary I may say a word. All that is needed is that the circuit be broken when the dynamo is running at less than the storage speed. This is easily managed by a governor attached to the dynamo shaft, and which makes and breaks contact in a mercury pool at the required speeds. I have also tried a form of governor which throws a greater or less number of cells into the

† Paper by Prof. J. Blyth, read before the British Association at Edinburgh.

charging circuit as the wind varies, and in this way the machine is always doing some work.

We may next turn to the uses for which windmills are specially applicable. These are :—

1. *For Lighting Lighthouses.* — These are always in exposed situations, where wind is plentiful, and often in such out-of-the-way places that stores and coal for generating the electric light in any other way could only be sent with difficulty.

2. *For the Lighting of Private Country Mansions.*—Here, whatever form of power is used, accumulators must be provided. The wind, I think, specially recommends itself, from its cleanly nature, if it can be applied without the trouble of much attendance.

3. For factories so situated that a suitable mill could be placed on the roof, and thus be in an exposed situation.

In closing, I may just refer to the probability that the present system of electric lighting by incandescence will be superseded by some method of getting light from cold sources. When we think that 99 per cent. of the energy spent in a gas flame is waste, as far as light is concerned, that a percentage almost as high in the electric light is also waste, we are strongly tempted to think that lighting by incandescence cannot be a final form. Recent discoveries have distinctly proved that rapidly-oscillating currents send out waves exactly similar to light-waves, but only having a much greater wave-length. Attempts have been made to get alternate-current machines of such frequency as to send out such waves. Should these be successful, then light will be generated with much less expenditure of energy, and windmills of even very moderate power may be all that is required. I can quite easily fancy the time coming when each house has its own little windmill storing current which may be used to drive such machines as those alluded to, and giving a light suitable for the house. We should not require to drive large steam engines in order merely to let us see each other or read a newspaper.

Metal Trade Memoranda.

The Hafla Ironworks, Sweden, manufacturing the well-known brand of bars "L.A.," have been closed.

Through the present depression in the Welsh tinplate trade, nearly twenty works were closed on the 27th ult. for an indefinite period.

During the month of July, Brit'sh North America exported 1942 tons of copper ore to Great Britain, as compared with 1135 tons in July, 1891.

The production of zinc in Europe last year was 234,775 tons. The corresponding output in 1890 was 283,245 tons. British zinc figured in these totals for 29,410 tons and 29,145 tons respectively.

The Gwendraeth Tinplate Works, Kidwelly, employing 700 hands, ceased operations on the 24th ult., and the works will be closed till the new year, in consequence of the great depression in the tinplate trade.

Notwithstanding that most of the Australian copper mines, and a large number of those in America, are either closed or being only partially worked, as the result of discouraging market conditions, the Japanese contemplate reopening a copper mine at Musashi.

Between the Eston Steel Works and the Cleveland blast furnaces, Messrs. Bolckow, Vaughan and Co. are engaged in erecting plant where they can mix the molten iron from the furnace before it is sent on to the Bessemer converters. By aid of this plant they expect to be able to mix the iron more effectually, and so secure a more uniform quality of rail or plate.

The metallurgical industry in Russia, exclusive of Finland, produced in 1891, 936,000 tons of pig iron, against 873,000 the preceding year. In 1887 the production only amounted to 600,000 tons. It is in provinces of the south that the increase has been the greatest. In 1886, the production of the industries in the south and the south-west only reached the sixth part of that of the Oural districts; last year it increased to one half, although the production of the districts of the Oural has itself increased by 42 per cent. during the last five years.

A company entitled the National Iron and Steel Company has been formed in Mexico to acquire numerous properties, including forests, deposits of iron and coal (in the States of Hidalgo and Jalisco), and iron mines and foundries, including the foundry and workshops of "Las Delicias" in the city of Mexico. Among the proposed measures to develop the existing industries is the erection of a Siemens-Martin plant with a producing capacity of fourteen tons per day, which is expected to commence operations within six months; and, secondly, the erection of a Bessemer plant at Comanje for the manufacture of rails and Government ammunition and armaments.

The Metal Market.

PRICES CURRENT.

LONDON, August 29.

COPPER opened firm at Friday's official value, and, owing to covering operations, buying orders from America, and a continued good demand for India, prices have steadily advanced, and the close is 2s. 6d. to 3s. 9d. better with a steady tone. Sharp cash was done at £44 3s. 9d. and £45 6s. 3d., three to seven days prompt at £44 7s. 6d., and three months at £44 13s. 9d. to £44 15s. Sales, 450 tons. Settlement price, £44 5s. For yellow metal 4 13-16d. per lb. has been bid, but refused. English tough, £47 to £47 5s.; best selected, £48 10s. to £48 15s.; strong sheets, £56.

TIN was quiet at previous rates at the opening, and afterwards became easy, the want of confidence inducing holders to freely meet the demand, and prices inclined 5s. for three months and 10s. for cash, at which the market closed with a quiet tone. Three months sold at £93 10s. to £93 5s., and cash at £93 5s., the greater portion being for the former positions. The total sales covered 75 tons. Settlement price, £93 5s. English ingots, £96 to £96 10s.

PIG IRON.—Scotch opened easy in sympathy with advices from Glasgow, and business was recorded for early delivery at a loss of 1½d. Later on values further declined, and after three months fixed, which was done early at 42s. 9d., had passed at 42s. 8d., with delivery placed in buyers' option, the close was quiet at 3½d. decline. Sales, 2000 tons. Middlesbrough and hematite are unchanged and steady. Settlement prices:—Scotch, 42s.; Middlesbrough, 41s.; hematite, 50s.

TINPLATES steady. I.C. cokes, f.o.b. Liverpool, 12s. 6d.; London, 13s.; Swansea, 12s. 6d.

LEAD.—Spanish still sells at £10 6s. 3d., but the tone is quiet. English, £10 10s. to £10 12s. 6d.

SPELTER is flat and 2s. 6d. lower, the nearest price being £20 15s. Silesian specials, £22, ex ship, sellers.

ZINC SHEETS.—Silesian remains inactive at a decline of 2s. 6d. Ordinary, ex ship, £23 7s. 6d. Belgian quiet and unchanged. V.M.'s, £24 ex ship, and £23 15s. f.o.b. Antwerp.

OFFICIAL CLOSING QUOTATIONS.

	£	s.	d.	£	s.	d.
COPPER—						
G. M. B.—Cash	44	6	3	44	13	9
„ Three months	44	16	3	45	3	9
English tough	—			—		
Best selected	—			—		
Strong sheets	—			—		
TIN—						
Fine foreign—Cash	93	5	0	93	15	0
„ „ Three months	93	5	0	93	15	0
Australian—Cash	94	5	0	94	15	0
PIG IRON—					s.	d.
Scotch warrants Cash					42	0
„ One month					42	2½
Middlesbrough—Cash					41	0
„ One month					—	
Hematite—Cash					50	0
„ One month					—	

GLASGOW, August 29.—The pig iron market was flat. General selling of Scotch was engaged in for various reasons. Cholera stopping shipments to Hamburg, the small increase of iron in Middlesbrough stores, decreased Scotch shipments, and bad trade outlook, all being put forward. Close on 30,000 tons must have been dealt in, including nearly 10,000 tons at 42s. and 41s. 11½d. a month, with 1s. forfeit in sellers' option. Since Friday Scotch has lost 4d. Cleveland and hematite have been idle, but the latter is quoted 6d. dearer. The shipments last week were 5097 tons, being a decrease, compared with the same week last year, of 2622 tons.

QUOTATIONS.

	Highest.		Lowest.	
	s.	d.	s.	d.
Scotch warrants—Cash	42	3	41	11½
„ One month	42	5½	42	1½
Middlesbrough—Cash	41	0	41	0
„ One month	—		—	
Hematite—Cash	50	0	50	0
„ One month	—		—	

Official Gazette.

Partnership Dissolved.

GRIST AND TURNER, Gracechurch-street, City, electrical engineers and contractors.

THE BANKRUPTCY ACTS, 1883 AND 1890.

Receiving Order.

ALFRED GEORGE HAMILTON, Argyll-p'ace, Regent-street, W., and Ridgmount-gardens, W.C., mechanical engineer.

Adjudication.

JEREMIAH CANNIFFE, Great Saffron-hill, Holborn, and the Terrace, Higham-hill, Walthamstow, engineer.

Trade Marks.

The following is the Official List of Applications published from August 17 to August 24, for the Registration of Trade Marks, so far as relates to the Metal Trades.

CLASSES 5, 12 AND 13.

165,274. Unwrought and partly wrought metals used in manufacture. EDWARD FINCH, jun., and MALCOLM PATTERSON LUPTON, trading as T. P. HEARNE AND CO., 38, Leadenhall-street, London, E.C.; merchants and agents.—7th June, 1892.

165,275. Cutlery and edge tools, including files, saws, skates, shears, scissors, and razors. EDWARD FINCH, jun., and MALCOLM PATTERSON LUPTON, trading as T. P. HEARNE AND CO., 38, Leadenhall-street, London, E.C.; merchants and agents.—7th June, 1892.

165,276. Anvils, hammers, hoes, spades, shovels, and other metal goods and tools not having a cutting edge in Class 13, but not including forks or any goods of a like kind. EDWARD FINCH, jun., and MALCOLM PATTERSON LUPTON, trading as T. P. HEARNE AND CO., 38, Leadenhall-street, London, E.C.; merchants and agents.—7th June, 1892.

CLASS 5.

OLTEANCA.

166,095. Unwrought and partly wrought metals used in manufacture, rough, pig, or ingot; hoops, wires, bars, rails, bolts, sheets or plates of iron, steel, lead, copper, zinc, tin, bismuth, antimony; also precious metals in ingots. JOHN WILLIAMS AND CO., 11, Orange Court, Castle-street, Liverpool; iron, steel, and tinplate merchants.—21st July, 1892.

CLASS 5.

FINSPONG.

166,194. Iron and steel. AKTIEBOLAGET FINSPONGS STYCKEBRUK, Finspong, Sweden; iron and cannon manufacturers.—26th July, 1892. Mark used since the year 1856. *Address for service in the United Kingdom*, c/o The Trade Mark Owners' Mutual Protection Association Limited, 17 and 18, Basinghall-street, London.

CLASS 13.

ALBERT.

165,582. Nuts, screws and bolts. KIRBY BANKS, trading as BANKS AND STEAD, Albert Screw Works, Meadow-lane, Leeds, Yorkshire; manufacturer of nuts, screws, bolts, etc.—23rd June, 1892. Mark used since eleven years before the 13th August, 1875.

CLASS 50.

163,000. Packing for making fluid-tight joints. The RICHTER MANUFACTURING CO., West End Mills, Bradford, Lancashire; manufacturers.—16th July, 1892.

New Companies.

COMPOUND MOTOR CO. LIMITED.—This company was registered on the 18th ult., with a capital of £200, in 1s. shares, to carry on the business of engineers, merchants, bankers, brokers, shippers, etc. Registered by Mr. E. C. Wyvill, 35, Bucklersbury, E.C.

IMPROVED STEEL SYNDICATE LIMITED.—This company was registered on the 22nd ult., with a capital of £7000, in £200 shares, to acquire, develop, and turn to account, patents, inventions, etc., relating to improvements in the manufacture of steel, iron, or other metals, and to carry on the business of engineers, manufacturers, and contractors. Registered by Messrs. Greenop and Sons, 9, Gracechurch-street, E.C.

MONIER PATENT CONSTRUCTION SYNDICATE LIMITED.—This company was registered on the 18th ult., with a capital of £10,000, in £10 shares, to acquire, work, develop, and turn to account the letters patent for the United Kingdom No. 3377 of 1883, and No. 3835 of 1886, to carry on the business of designers for, manufacturers of, contractors for, and dealers in constructions upon the Monier system. Registered without articles of association, by Messrs. Limbrey, Higgs and Co., 43, Finsbury-square, E.C.

PATENT WATER-BRAKE SYNDICATE LIMITED.—This company was registered on the 22nd ult., with a capital of £2000, in £10 shares, to adopt and carry into effect an agreement to be made between Mr. F. Barnett of the one part and Mr. F. C. Duttson (for the company) of the other part, and to acquire, develop, and turn to account certain inventions, particulars of which are not given. Registered by Mr. F. Barnett, 106, Queen Victoria-street, E.C.

JOHN H. WILSON AND CO. LIMITED.—This company was registered on the 19th ult., with a capital of £20,000, in £10 shares, to acquire, take over as a going concern, and carry on the business of manufacturer of cranes, winches, derricks, diggers, boilers, travellers, pumps, hoists, etc., carried on by Mr. F. Bradley under the style of "John H. Wilson and Co," at Liverpool and elsewhere; and with a view thereto to enter into a contract in the terms of the contract referred to in clause 3 of the articles (with the said F. Bradley). Registered by Mr. T. T. Hull, 22, Chancery-lane, W.C.

KENNEDY STORAGE BATTERY CO. LIMITED.—This company was registered on the 24th ult., with a capital of £100,000, in £1 shares, to enter into and carry into effect an agreement expressed to be made between Messrs. Patrick Kennedy and C. J. Diss of the one part and the Company of the other part, to acquire certain letters patent for "Improvements in Secondary or Storage Batteries," and to carry on the business of electricians, electrical contractors, electrical and mechanical engineers, suppliers of electricity and manufacturers of electrical apparatus. Registered office, Broad-street House, E.C.

Miscellaneous Items.

A new harbour and docks are projected on Dauphin Island, at the mouth of Mobile Bay, Alabama, to cost £750,000.

A through telegraph wire from Calcutta to Madras is about to be erected. The length of the new line will be 1900 miles.

Messrs. H. Samuel and Co.'s tank steamer, "Murex," passed through the Suez Canal on the 25th ult., thus inaugurating the bulk-oil system to the East.

The general director of the Austrian State Railways has decided to adopt electric lighting at the station at Bregenz, and Messrs. Kremezky, Meyer and Co., of Vienna, have been instructed to carry out the installation.

By a new Post-office regulation, to come into force on September 1, the payment of postal orders may be postponed for a period not exceeding ten days, if the sender writes his wish to this effect across the face of the order.

The following will make a good cement for joints of steam or water pipes :—5lb. Paris white, 5lb. yellow ochre, 10lb. litharge, 5lb. red lead, 4lb. black oxide manganese. The whole is to be well mixed, and a little asbestos and boiled oil added.

A novel application of electric traction is now in use at Albany, U.S.A., in the shape of an electric tramcar used for watering the roadway. The car is capable of holding 2000 gallons of water, and is operated as an ordinary passenger car.

A vessel is reported to be now in Dublin Harbour discharging 3000 tons of gas coal, which has been brought from Philadelphia. The American coal, it is said, has been landed at a price materially below that at which coal of equal quality could be had from England or Scotland.

The Inman and International steamer, "City of New York," has further reduced the Atlantic record. She arrived off Queenstown on the afternoon of the 23rd ult., having performed the eastern passage in 5 days 19 hours 57 minutes. She left Sandy Hook at 8-20 p.m. on Wednesday, the 17th ult., and arrived off Daunt's Rock, Queenstown, at 4-17 p.m. on the following Tuesday. During the passage light winds from N.W. to S.W. were experienced, and the steamer averaged 20·11 knots per hour.

In last year's travelling on the railways of the United Kingdom, 845 millions of passengers were carried. The deaths from accidents to trains, rolling stock, or permanent way numbered five. To these have to be added further accidents attributable to negligence, incaution, or misconduct; but the proportion of passengers killed or injured from all causes whatsoever is but one in 8¼ millions. This computation takes no note of the million and a half season ticket-holders who travel daily to and from the great towns.

Captain Tozer, the chief of the Birmingham Fire Brigade, has invented an ingenious contrivance which will serve the purpose of a portable fire-alarm and first-aid station. By breaking a small pane of glass in the case a policeman's whistle and the key which unlocks the door can be extracted, while the action of opening the door rings a bell at the fire station. Inside the box there is a telephone, a box of ambulance materials, a sliding ladder which can be made to reach the height of 20ft., and a hand pump. The National Telephone Company have supplied the telephone and alarm arrangements.

The Milford Haven Docks Company, in their report issued on the 23rd ult., state that it remained to place the special debenture stock authorised by the Act, in order to provide the means for the acquirement of the pier and railway, which it was hoped would lead to the selection of Milford Haven as a port of call for transatlantic steamers, and result in great advantage to the company. Plans for the extension of the pier to the depth of 30ft. at low water, so as to enable the largest liners to land passengers, mails, and cargoes in the haven without the necessity of entering the docks, have been approved by the engineers and directors.

The publisher of "The Mechanical World" will send a prepaid parcel of specimen copies to anyone, in any part of the world, who can distribute them advantageously amongst his engineering friends. Business card or bill-head should be enclosed as a guarantee of good faith, and number of copies stated.—Address: 391, Strand, London, or New Bridge-street, Strangeways, Manchester

Queries.

☞ Readers are invited to avail themselves of this section for practical information on questions relating to Mechanical Engineering and the Scientific Industries.

☞ Queries and Replies should arrive at the Manchester Office not later than by the first post on the Tuesday preceding the date of publication.

MAKERS OF STAMPED FORGINGS [illegible] the names and addresses [illegible] drop stamped joints [illegible] ties.—J. T.

TINPLATE M[illegible] the paper [illegible] ing [illegible]

EXPANDING RIMERS.—Will "W. A. S. C." kindly give further information *re* expanding rimers as promised, if possible?—J. W. C.

NICKEL.—In an alloy of cast iron and nickel what is the increase in strength over cast iron, and what proportion of nickel should be used?—T. C.

JAMES' PATENT SOUNDING MACHINE OR SUBMARINE SENTRY.—Can any reader oblige with particulars of this apparatus, or name of makers?—J. P.

ECONOMISER SCRAPERS.—What means must I adopt to renew some broken scrapers in the middle of the range of pipes in the economisers?—PUZZLED.

PATTERNMAKER'S TOOL BOX.—Will any reader give me a sketch of the patternmaker's tool box, with full dimensions and particulars?—APPRENTICE.

MAKERS OF COMPRESSED PAPER.—Will any reader inform me of the address of a maker of compressed paper, such as is used for carriage wheels and the like?—T. D.

RIFLING MACHINE.—I should be glad of a sketch of any appliance used for rifling out small barrels, such as revolvers, etc., say ¼in. to ⅜in. bore, with threads, say, 6in. pitch.—NEMO.

WOVEN BELTING.—Can anyone give me the recipe for or supply me with the proper paint for cotton belting? I can weave it right enough, but cannot get a satisfactory paint.—BARCELONA.

HARDENING CIRCULAR SAWS.—Can anyone tell me how to harden a circular saw 20in. diameter and ⅛in. thick, to saw cast iron? I want to harden the cutting part only, and not the body of the saw.—J. WILSON.

HOT-AIR ENGINE.—Will some reader of THE MECHANICAL WORLD kindly oblige me with a section and principal dimensions of a ½H.P. single-acting hot-air engine of the Stirling cycle?—G. H. PERKINS, North Queensland.

FILLING TANK.—If a tank has two pipes so fitted that it can be filled in either thirty-five minutes by one, or in an hour by the other, and if the discharge pipe will empty it in half-an-hour, how can the time be found that it will take to fill the tank when all three pipes are open?—INVENT.

VOSPER'S ENGINE.—I have a Vosper's patent high-speed four-cylinder engine, and should be glad to know what the cut-off in each cylinder should be; also the position of eccentric sheave at any given point? I believe the eccentric sheave has been altered before the engine came into my hands. A sketch would oblige.—R. F.

LOSSES IN STEEL FURNACES.—Could any reader kindly inform me the average per cent. of actual loss, and the average per cent. of skull, in the charge of a Siemens open-hearth steel furnace working charges of from 30 to 40 tons? And also the per cent. of loss in heating slabs and ingots in the Siemens regenerative gas furnace?—J. R. R.

TRACTIVE FORCE.—(1.) If 120lb. per ton be a sufficient tractive force to draw a load on a level road, what tractive force per ton will be required to draw the load on a road inclined 1 in 30? (2.) A traction engine weighs 6 tons, and is capable of drawing 20 tons over a level road; what will it draw up a road which is inclined 1 in 100? Coefficient of traction = 0·02.—F. B.

DYNAMO CONSTRUCTION.—I am constructing a small dynamo of the "Gramme" type. A pattern. It is to be shunt wound and to give 120 C.P. at 45 volts. I had decided to wind the field magnets with about 12lb. No. 18 double cotton-covered wire and the armature with about 3¾lb. No. 18. Now, I have been informed that I have got the resistance on the field magnet coils too low, and would like to know if this is the case or not?—T. WALLEY.

BOAT PROPULSION.—If a boat floats down a river, will it be carried forward at the same speed as the stream is flowing? Or can it be proved that it will go slower than the stream? How much force in lb. will be required to propel a boat of a given weight against a stream or up a river flowing with a certain velocity, so that the boat shall move up the river with the same speed that the stream is flowing down?—HYDRA.

WATER FLOWING INTO JET CONDENSER.—Will some fellow-reader kindly give me a worked-out example of the quantity of water that will flow through a 4in. pipe 30ft. long, with four bends, into a jet condenser with 18in., 2in., and 28in. of vacuum; wheel valve wide open, giving same area as pipe; also with it half open? The water supply tank is 8ft. below condenser. The condenser is working on a set of triple-expansion engines. What effect have bends and temperature on supply water?—SUGAR MILL, North Queensland.

LOCOMOTIVE CONSTRUCTION.—Will any correspondent enlighten me as to the mode adopted in locomotive work in order to fix the position of the axles (horizontally) so that each axle may have a predetermined portion of the total weight resting upon it? Say:—

Load on leading axle	.....	0·32
,, driving ,,	.....	0·48
,, trailing ,,	.....	0·20
		1·00

Of course, I am aware there are certain circumstances—such as length of barrel, position of firebox, etc.—which in practice to a great extent influence this; but the point I wish clearing up is: Given the total weight, how are the positions of axles determined so that the pre-arranged weights rest on them? An answer would be of service to others as well as to—HILLSLAND.

Replies.

☞ Owing to the constant increase in our correspondence, we regret that we have no alternative but to announce that we cannot reply by post to Queries even when stamped envelopes are sent.

☞ Queries and Replies must in all cases be accompanied by the names and addresses of the writers, as no notice will be taken of anonymous communications.

D. MABY.—You can obtain the brass from Messrs Evered and Co., Drury-lane, London.

P. THOMAS.—See articles on "Tempering Tools," in our issues for September 25, October 2 and 16, 1891.

B. J.—We are obliged for your reply, but we have already given as much space as we can spare to the matter.

THEORETICAL.—Have you tried asbestos millboard, as supplied by Messrs. Bell's Asbestos Company Limited, Southwark, London?

HEATING PIPES (Glasgow).—They should not be subjected to more than 40lb. pressure, and you will therefore need a reducing valve.

NOVICE.—The amount of work done in the cylinders should be approximately equal, so that a larger diameter is necessary when the steam pressure is less.

T. T. T.—See an article in our issue for January 24, 1891, on "Auxiliary Engines in Connection with the Modern Marine Engine." We are afraid we cannot assist you further.

W. P. STOKER.—If you wish for a book on boiler construction, etc., Wilson's "Steam Boilers" (6s.), or Munro's "Steam Boilers" (3s. 6d.) will suit you. They may be had from our office.

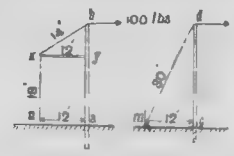
CHAS. PERCIVAL.—A screw pile is a foundation pile turned into the ground by means of a tapered screw of one or more convolutions at its lowest end. It is used in ground too hard or unreliable for the reception of driven piles.

CRICHTON.—It depends greatly upon the speed of the pump plunger. If this is high, the smaller inlet valve will not allow the barrel to be filled at each stroke, but the velocity through the discharge valve would be greater than at present.

MAKERS OF CELLULOID.—Required the names and addresses of extensive makers of celluloid.—B. P.——*A.*—The British Xylonite Company Limited, 124, High-street, Homerton, London, E, are makers.

ROLLER-BORING TACKLE.—Will some reader favour me with a sketch of a tool for boring hard wood rollers of various kinds in the lathe from 1ft. to 3ft. in diameter, and from 3ft. to 5ft. long? The holes are to pass right through, and to be from 1in. to 3in. diameter.—BORE.——*A.*—Tools for boring hard wood rollers can be had from Andrew Sproul and Sons, engineers, Paisley.

STAYING TELEGRAPH POSTS.—*a b* and *c d* are two telegraph posts of equal height, firmly fixed into the ground. How can *m d* be



proved to be a stronger way of staying than *n x b*? Also, what is the compressing thrust on the strut *x y*, and the bending moment about *y*?—TELEGRAPH POST.——*A.*—Referring to my letter on the staying of telegraph posts, which appeared in your last issue, I find an error has crept in. The third line above Figs. 3 and 4 reads thus:—The force at *c* will be in the same direction as the force *d* R', thereby making the total force at *d* more than 100lb., etc. For the letter *c*, as above, should be substituted the letter *d*.—E. RAMSBOTTOM.

Prize Competition.

WE OFFER FOUR GUINEAS MONTHLY IN PRIZES FOR THE BEST ORIGINAL ARTICLES SENT IN ON ANY MECHANICAL, ENGINEERING OR ELECTRICAL SUBJECT.

IN ORDER THAT MANAGERS, DRAUGHTSMEN, FOREMEN, AND WORKMEN WHO HAVE HAD NO PRACTICE IN WRITING MAY NOT HESITATE TO SEND IN COMPETITIONS, IT IS TO BE UNDERSTOOD THAT ALL ARTICLES WILL BE FULLY EDITED AND CORRECTED, AND JUDGED OF SOLELY ON THEIR MERITS AS ORIGINAL CONTRIBUTIONS FROM A PRACTICAL POINT OF VIEW. THE OBJECT OF THE COMPETITION IS TO INDUCE PRACTICAL MEN TO COME FORWARD AND GIVE THE RESULTS OF THEIR EXPERIENCE.

CONDITIONS.

Competitions for our Monthly Prizes must be sent so as to arrive at the Manchester Offices of THE MECHANICAL WORLD, New Bridge-street, not later than the last Tuesday in each month. Articles arriving after that time will be placed in the following month's competition.

Written competitions must be on one side of the paper only. The contributions must be original, and relate to matters connected with Engineering, Mechanism or Electricity.

The Proprietors of THE MECHANICAL WORLD reserve the right to publish any competition, whether it gains a prize or not.

The competitions may be accompanied by diagrams, sketches or drawings.

Competitors should write the words "Prize Competition" on the envelopes.

Competitors are not confined to one, but may send any number of competitions.

The correct name and address of the sender *must* be distinctly written upon every competition, not necessarily for publication. Competitions can appear under a *nom de plume*.

☞ **We cannot undertake to be responsible for any MSS. sent to us, though when stamps are enclosed for the purpose we will endeavour to return rejected contributions.**

Latest Inventions.

APPLICATIONS FOR LETTERS PATENT.

When Patents have been "communicated," the name of the communicating party is printed in italics.

Where complete specification accompanies application, an asterisk is suffixed.

15th August, 1892.

14,672 SUPPLYING AIR to FURNACES. W M Greaves.
14,674 ELECTRIC TELEPHONIC TRANSMITTING APPARATUS. A Marr.
14,676 COMMUTATORLESS DIRECT CURRENT DYNAMO-ELECTRIC MACHINES. A Cuthbert.
14,677 PACKING RINGS for PISTONS. T Smith.
14,693 SPRINKLER or AUTOMATIC FIRE EXTINGUISHER. F F Farlow.
14,696 PISTON and GLAND PACKING. J Walker.
14,709 WIND MOTORS. G E Moore.
14,711 ENGINE WORKED by ETHER or VAPOUR.* P de Susini.
14,712 ENGINE WORKED by ETHER or VAPOUR in COMBINATION with a STEAM ENGINE.* P de Susini.
14,713 ENGINES WORKED by ETHER or VAPOUR in COMBINATION with a GAS ENGINE.* P de Susini.
14,718 DOUBLE-ACTING BORING MACHINE. H W Burmester.
14,719 ELECTRICAL STORAGE BATTERIES. T Floyd.
14,720 ELECTRICAL STORAGE BATTERIES. A J Jarman.
14,723 BREAKING and BEATING ENGINES for GRINDING or BEATING PULP. J Beveridge.
14,732 MEASURING APPARATUS. A Ross.
14,736 GREASE LUBRICATORS. W W Branston.
14,737 TRAMWAY RAILS. J Perriman.
14,738 ELECTRIC ARC LAMPS.* C Coerper.
14,739 CONVERTING PULVEROUS METAL IC OXIDES INTO SOLID ORES. N Henzel.
14,741 DEVICES for MEASURING CIRCLES and OVALS. L Courlander.

16th August, 1892.

14,743 COMPRESSING and STAMPING MACHINERY. J Whetnall and others.
14,745 REVERSING or ADJUSTING MECHANISM for the BLADES of SCREW PROPELLERS. F R Simms. (*R Ho'tz*, Germany.)
14,755 VALVES for AUTOMATIC AIR BRAKES for RAILWAY CARS.* G A Boyden.
14,766 UNIVERSAL ROLLING MILL.* A Reese.
14,768 BALL BEARINGS.* M J O'Donnell.
14,769 BRUSHES for DYNAMOS.* W P Thompson. (*H H Cherry and others*, United States.)
14,782 AUTOMATIC DISENGAGING GEAR for BARRING ENGINES. C Walmsley.
14,787 SOLDERING ALUMINIUM to ALUMINIUM and OTHER METALS. J Mandt and H Huhnholz
14,795 HYDRAULIC BRICK PRESSES.* J J Koch.
14,796 STEAM GENERATORS.* R Haddan. (*G W Sloane*, United States.)
14,799 ELECTRICAL SWITCH. A H Vesey.
14,805 ELECTRIC ARC LAMPS. H R Low.
14,805 MOTORS for ALTERNATING CURRENTS. H R Low.
14,813 ELECTRIC BATTERY PLATES.* E P Usher.
14,814 STORAGE BATTERIES.* E P Usher.
14,815 STORAGE BATTERIES.* E P Usher.
14,816 ELECTRIC BATTERY PLATES.* E P Usher.
14,818 CHAIN. J F Golding.
14,819 ELECTRIC ARC LAMPS. H Watt.
14,820 STONE GRINDING MACHINES.* W J Knowlton.
14,822 INCANDESCENT ELECTRIC LAMPS.* H H Lake. (*E McOuat*, United States.)
14,823 FRICTION CLUTCHES.* H H Lake. (*E Waldron*, United States.)

17th August, 1892.

14,832 EXCENTRIC CRANK CAM or TOGGLE JOINT PRESSES. D Smith, jun.
14,833 ENGINE for PROPELLING BOATS WITHOUT STEAM or ELECTRICITY. H G Dallimore.
14,834 PITCH CHAINS for DRIVING. E Nicolas.
14,840 APPARATUS EMPLOYED for SETTING HARD BODIES in the WORKING SURFACE of CUTTING TOOLS.* W Brierley. (*R Lorcke and others*, Germany.)
14,843 BRAKE SHOES USED AGAINST the WHEELS of RAILWAY ROLLING STOCK. T Milburn. (*C W Bloomfield*, United States.)
14,848 FLEXIBLE TUBES or PIPES or TUBULAR ARTICLES. W Hunter.
14,853 SIGNALS for RAILWAYS. C E Hiscock.
14,858 MOUNTING and FIXING PADS for LUBRICATING JOURNALS and JOURNAL BEARINGS. W and I Darby.
14,859 TELEPHONIC CONNECTIONS. H L T Lyon.
14,863 DEVICES for STREET BOXES for COVERING the VALVES for WATER and OTHER SERVICE PIPES. R T Preston.
14,869 MOTOR MECHANISM APPLICABLE to WHEELED VEHICLES and MARINE PROPULSION. G F Lutticke.
14,880 APPARATUS for SUPERHEATING STEAM and OTHER VAPOURS and GASES. M Honigman.
14,887 STEAM BOILING APPARATUS. J O Peterson.
14,890 APPARATUS for the PRODUCTION of SUPERHEATED STEAM. A Bratoluboff.
14,891 WHEEL GEARING. A A Garside.

18th August, 1892.

14,895 ROCK DRILLS.* T F Farrel.
14,900 ELEVATORS. J Buchanan, jun.
14,913 PUMPS.* G T Hyde. (*Julius Maemecke*, Germany.)
14,920 ALUMINIUM SOLDER. E Goll and C Vatcky.
14,928 NON-SPARKING SWITCH.* F H Medhurst.
14,947 PLATES or ELECTRODES of ELECTRIC STORAGE BATTERIES. A J Jarman.
14,949 PERCUSSIVE DRILL MECHANISM. J Dulait.

19th August, 1892.

14,950 CONSTRUCTING SPANNERS, WRENCHES, etc. J Howlett.
14,963 METAL WORKING TOOLS. C J L Leffler.
14,964 NUTLOCKS. J R Peacock and S Ward.
14,974 ELECTRIC MEASURING INSTRUMENTS. W T Goolden and S Evershed.
14,976 AUTOMATIC VALVE GEAR for CONTROLLING the SUPPLY of WATER to HYDRAULIC RAMS. J Keith.
14,997 GAS GOVERNOR. G Zahikian.
14,999 APPLIANCES for the PRESERVATION of TUBE PLATES of MARINE BOILERS. E A Cowper.
15,002 TRANSMITTING TELEPHONIC SIGNALS THROUGH LONG DISTANCES. J Hines.
15,004 METALLIC PACKING.* W H Bodfish and others.
15,011 NEUTRALISING or COUNTERACTING the PRESSURE of the JOURNALS of RAPIDLY-ROTATING SHAFTS. C G P de Laval.
15,013 PREVENTING the FOULING of SCREW PROPELLERS. F Thompson. (*J Thompson*, China.)

20th August, 1892.

15,020 PARALLEL VICES. W P and T Fox.
15,026 AUDIBLE ALARM SIGNALS for "SLIP COACHES" of RAILWAY TRAINS. H Williams.
15,027 HEAD and BUCKET VALVES for PUMPS. W Cooper.
15,029 SAND BLASTS. G Green and F G Thompson.
15,033 STEAM ENGINES. W Menzies and J Stenhouse.
15,035 AUTOMATIC SWITCHES. J H Rider.
15,037 STEAM VACUUM PUMPS. F Quenstedt.
15,048 JOINING and SECURING the RAILS of RAILWAYS.* T Stirland and J Singleton.
15,052 FIRE-BARS for FURNACES. W P Thompson. (*C W Fleischmann* and *C Fischer*, Germany.)
15,054 GOVERNORS of STEAM ENGINES. J Jones.
15,058 ALLOYING the SURFACES of METAL WIRES, STRIPS, PLATES, and SHEETS.* E Martin.
15,062 APPARATUS for RETURNING the WATER of CONDENSATION into BOILERS. L Johnstone.
15,066 ELECTRICAL CUT-OUTS for HIGH-TENSION CURRENTS. C E Webber and G H Nisbett.
15,068 STEAM ENGINES. M H Robinson.
15,069 MULTITUBULAR BOILERS. M C Drory.
15,071 EXPLOSION ENGINES. R Edwards.
15,075 FURNACES for PUDDLING, WELDING, ANNEALING, etc. J von Langer and L Cooper.
15,080 INSTRUMENTS for MEASURING ANGLES. C A A Barnes.

Manuscript Specifications of Patents can be examined at the Patent Office, London, after the Complete Specification has been accepted, on payment of 1s. The printed Specifications are usually published in about one month after acceptance of the Complete Specification, and any single copy may be obtained by remitting 8d. in stamps (or by special post cards sold at the Post Offices at 3d. each) to SIR H. READER LACK, *Comptroller General, Patent Office, 25, Southampton-Buildings, Chancery-lane, London. When a number of Specifications are required, remittances may be made by P.O.O.*

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This question it will be the province of "GOOD HEALTH" to discuss, the physical well-being of the individual and of the community being the sole object aimed at. Diseases and their remedies will be discussed in a popular manner, by medical men of experience: sanitation will be fully treated of by experts, and food and drink will be considered from every possible point of view.
To provide sustenance for the people of the United Kingdom, we pay the foreigner over £141,000,000 a year for foodstuffs, in addition to the money disbursed amongst producers at home. This does not include the cost of drinkables. The immense importance of the subject will therefore be readily perceived.
One of the most prominent features will be the question of adulteration, all the more important to the public because it is so difficult to detect, and almost impossible to avoid. To further this object, analyses will be regularly made of the various articles of common use, from different parts of the kingdom, so that, at all events, if our readers insist upon buying adulterated articles they may know when they are going to eat them.
The sources of food supplies will be written of, and processes of manufacture will be inquired into.
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The Mechanical World

EVERY FRIDAY. ONE PENNY.

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We wish it to be distinctly understood that we cannot, for any consideration, and will not knowingly, allow our editorial columns to become the vehicle for mere advertisements of machinery, apparatus, or anything that falls within our province to notice.

Every correspondent should forward his name and address, not necessarily for publication unless so desired. We do not undertake to return MSS. unless specially requested, and in such cases stamps should always be sent.

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We are adopting special means of ascertaining what firms in the engineering and metal trades do and do not take in THE MECHANICAL WORLD, and (at their request) are sending Specimen Copies of the journal to the principals of those firms who do not take it. As every copy so sent will undoubtedly be carefully examined from the first page to the last, THE MECHANICAL WORLD will, for the next few months, be an even more valuable medium for advertising than heretofore, while permanent advantages are bound to accrue to the journal in the shape of further increase in circulation.

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FRIDAY, SEPTEMBER 9TH, 1892.

High-speed Corliss Engines.

ALTHOUGH it is generally conceded that high rotative speeds are unsuitable for engines fitted with liberating or detachable valve gear, of which the various types of Corliss engines are the best-known examples, yet by adopting comparatively long strokes fairly high piston speeds are obtained, attaining in some instances to 700 or 800ft. per minute. But while in this country piston speeds of from 250 to 700ft. per minute are commonly met with, we do not usually find the number of revolutions exceeding about 90 or 95 per minute. Possibly some of our readers may be aware of Corliss engines running at higher rotative speeds than this—and, if so, we shall be pleased to have particulars of them; but we believe very few engines of this type will be found running at much greater rates. In the United States, a constant endeavour has been made to so modify the valve gear as to allow higher rotative speeds to be employed. Various so-called improved Corliss valve gears have been introduced with this end in view, but no very great improvement has yet been effected; indeed it would appear that at the present time the original type of Corliss engine is capable of outdistancing all its imitators in the matter of high-speed running. According to Mr. S. Webber, of the Trenton Iron Company, Trenton, U.S.A., there is in the works of that company a Corliss engine, built by the late Geo. H. Corliss, of Providence, R.I., which has been in operation for 12 out of the 15 years which have elapsed since its erection in 1877, driving a Belgian wire-rod train of rolls and running at from 165 to 170 revolutions per minute. The engine, which is of the regular Corliss type, has a cylinder 20in. in diameter, with a stroke of 42in., so that the piston speed is between 1155 and 1190ft. per minute, the former being the usual rate in regular work. The work imposed on the engine is somewhat severe, as steel wire rods are rolled from a 4in. by 4in. billet down to a No. 4½ (Am.) wire gauge at a single heat, yet the wear and tear is stated to be remarkably small, and the engine is in good working order at the present time. During the past year the initial steam pressure has been raised from 80 to 100lb. per sq. in., and the I.H.P. has at times reached 500, suddenly dropping to 200 or even to only 50H.P. in less than 15 seconds. When it is considered that even at the highest speed above mentioned the dash-pot pistons drop without a miss to the full point of closure, some idea of the capabilities of the Corliss gear becomes apparent. The fact of an engine working regularly at this high speed for 18 hours per day and during a period of 12 years' actual work, deserves, in our opinion, to be placed on record as an example of engine building which many of our *fin de siècle* engineers might emulate with advantage.

Economiser Explosions.

IT appears to be a commonly accepted notion among steam users and boiler owners that explosions of economisers or feed-water heaters are not matters of any great moment, and that the inconvenience of the escaping water and the necessity for repairs are the most serious consequences to be considered. As many of our readers are aware, however, facts point to a somewhat different conclusion, as several economisers have exploded with great violence, frequently causing great destruction of property, and sometimes being attended with loss of life. When the conditions under which economisers are worked are fully considered, such results are not altogether to be wondered at. Economiser pipes are made of cast iron, which is ever a treacherous metal, while they are exposed to as high or even higher pressures than the boilers to which they are attached. Moreover, the method of setting is not always unexceptional, and Mr. Lavington E. Fletcher has properly drawn attention to this point in his report to the Manchester Steam Users' Association. Frequently the setting is such as to render examination of the pipes on the outside a matter of utter impossibility, and in many cases corrosion is therefore going on unperceived, and gradually but certainly eating away the metal. Internal wasting of the pipes is of course very liable to occur owing to the corrosive action of the water passing through them, while external wasting may arise from damp in the seatings, leakage at the joints or condensation of the gases passing off from the fires. This latter cause operates most severely at the bottoms of the pipes, on account of the feed being introduced at that part, rendering the bottom colder than the top. Sometimes, as Mr. Fletcher points out, the feed water has been passed through a few pipes at the chimney end in the first instance, and then through the others, so that the colder part of the economiser should be exposed to the colder gases. So far as the abstraction of heat is concerned, this would appear to be the correct plan; but in practice it has been found that the pipes at the chimney end corroded so rapidly that this arrangement has had to be abandoned in favour of allowing the feed water to ascend through all the pipes equally, and this plan is now generally adopted. It is worth noting that the colder the feed water is the more rapid will this condensation occur; so that, generally speaking, those economisers last the longest which are supplied with water drawn from hot wells, or in which the feed is slightly heated by some other means.

The Brain System of Electric Traction.

THE latest contribution to the already numerous systems of electric traction has been devised by a Mr. Brain, of Liverpool, who in a pamphlet has set forth the details of his method. It is termed a covered conduit system, and is the outcome of a careful study for several years of every known method of employing electricity for street railway traction, and is also due to practical experience gained in operating several of the well-known systems. The conduit, which is made in the centre of the line, is built with a wide slot extending its whole length. In this conduit is laid a strong flat cover rail which rests upon ledges formed on either side of the top of the conduit. This rail firmly bridges over the opening, sinking down into it like a lid, and is said to be capable of carrying a weight of many tons at any point. The conduit consists of cast-iron troughing, laid in lengths and of such section that the upper edges rise to a level with the surface of the road. The conductor is supported in the centre of the conduit. The novel feature of the system is the cover rail, which, on being raised an inch or two at any point, falls back into its seat within a few feet on either side by its own flexibility. Under each car is carried a collector, which consists of a frame in which are mounted two small carrier wheels or roller. The cover rail being raised, the roller is placed in the wide opening underneath, so that it can support the cover rail high enough to allow part of the frame on both sides to pass under it into the conduit. When the cover rail is raised upon the roller, the smallest sized tramcars will, it is said, much more than cover the maximum length of rail raised. As the car is propelled along the road the collector roller raises the cover rail and travels along in the opening uncovered, the rail returning to its seat as the rollers pass away. At a little distance in front and behind the collector are fixed suitable rollers, which run over the cover rail surface, thus ensuring, it is claimed, its certain action and accurate return. Suitable arrangements are provided at crossing places, curves, points, etc. We understand that this system has been tested under the most severe conditions during the past two years. It will be readily understood that the cover rail in this system assumes a wave-like appearance as the car passes along, similarly to that of the hoop-iron conductor used in the closed-conduit system devised by Mr. Lineff. Whether Mr. Brain will succeed in getting his system adopted by tramway companies is very doubtful, considering the present position of the latter, but we imagine that it would hardly be suitable for use in large cities where there is a constant stream of heavy traffic, apart from the question of the method being permitted to be used by the authorities.

The Draining of the Zuyder Zee.

THERE appears some likelihood of another great engineering project once more receiving serious attention, as the commercial and technical societies of Holland have petitioned the Government to proceed with the long-contemplated work of draining the Zuyder Zee. The work is estimated to cost about £15,000,000, including, as it does, the erection of a dam 26ft. high and 25 miles long, as well as the removal and reconstruction of the coast defences. It may be of interest to point out that the draining of the Zuyder Zee was proposed by Van Diggelen in 1849, before the great work of draining the Haarlem Zee was completed. It was then rejected as impracticable, but it was again proposed in 1865, and plans for the work made by Mr. Beyerinch, who had conducted the drainage of the Haarlem Zee. The result was satisfactory, and the plans seemed practicable. In 1873 the Minister of the Interior appointed a committee of experts to examine into the feasibility of the plan. This committee declared it not only possible but desirable. In 1875 the Dutch Chamber voted the equivalent of £9,750,000 for the work, but nothing was then done. A solid, broad foundation has now been laid, extending from the north point of North Holland across to the Island of Wieringen, and thence straight across the Zee to the nearest point of the opposite coast of Friesland, a distance of 18 miles only. It has been found that as the work advances the sea itself assists by depositing large quantities of sand and silt at every tide, on both the outside and inside of the dam, which is being gradually, simultaneously, raised along its whole length. When the project of draining the Zee took shape 40 years ago, the first idea was to join by dams the great islands of the Texel, Vlieland, Terschelling, and Ameland to each other and to the mainland at each end. The total length of dams required for this would have been only the same as that from Wieringen to the Friesland coast, and it would have reclaimed from the sea about half as much again as the present plan; but the tide going in and out through these openings four times daily, with tremendous strength and in enormous volume, could not be coped with. It had hollowed out deep channels between the islands, from which it was considered vain to attempt to dislodge it. It is well established by history that the Zuyder Zee was once dry land and that the sea broke over it about 1282. The water in many places is shallow, only 4ft. and 5ft. deep. It is practically an inland sea, which at one time covered an area of 12,000 square miles, but about 400 square miles of this have been reclaimed, and by the work projected it is anticipated that the remainder will be reclaimed.

The Use of Mild Steel.

THE committee nominated by the Aachen section of the Society of German Engineers to consider the subject of steel in reference to recently developed processes, and its consequently extended adoption for purposes of construction, has issued its report, in which it is stated that the committee thought it advisable to confine itself to general questions and conclusions. The first point considered was: Is soft or hard steel preferable, under general conditions, for building purposes; what are the limits of strength which it is desirable to specify, and are any further tests required? The committee states that, generally speaking, soft steel is to be preferred. For ordinary commercial and industrial purposes, the tensile strength should be between 23·45 and 28·60 tons per square inch, the minimum extension 20 per cent. (in test bars 8in. in length), and the coefficient of quality (resistance and extension) 508. For bridge work the tensile strength should be between 23·45 and 27·30 tons per square inch, and coefficient of quality 572. It is not considered advisable to specify any chemical analysis, as the physical properties afford a sufficient index to the composition of the metal, and the result depends not only upon the quantitative identification of the component substances, but also upon their mechanical combination. In considering whether it is advisable to specify not only the class of material but also the precise method and conditions of its production, the committee is of the opinion that the specification must be limited to such general normal conditions for the identification of quality as can indubitably be conformed to, and that any minute limitations are technically impracticable and without result, and commercially injurious. As to whether any further precautions are necessary in the manipulation of steel (that is, in addition to the methods of working of wrought iron), the only point to be noted is that, unless unavoidable, the material shall not be worked when in the condition of blue-heat. The committee finally considered whether any increase in working loads is admissible, and if so, to what extent; and upon this point it is decidedly of opinion that the working load can be increased to 6·35 tons per square inch for live loads and 7·62 tons per square inch for dead loads.—"Zeitschrift des Vereines deutscher Ingeniure."

IT is stated that an electric railway is to be built at Kobé, Japan, to give readier access to the mountain resorts and direct communication with the Wakasa Gulf.

Scotch Shipbuilding in August.

FROM the return of the Scotch shipbuilding trade for August it would appear that the industry is experiencing a period of marked depression. At Greenock and Port-Glasgow, where the work on hand last year was sufficient to inspire a general strike against a reduction, there is now very little more than 80,000 tons, a total which the work in upper-reach yards could hardly exceed but for the presence at Fairfield of the big Cunarders. The corresponding decrease in the number of men employed in associated shipyards is equally conclusive. On the 30th September, 1891, there were nearly 16,000 men employed, but in three months the total fell to 13,000. A slight improvement was apparent during the first quarter of the new year, but in the succeeding three months there was a fall from 14,500 to 12,300. That the total is considerably less now may be taken for granted. To fill the many gaps left by the heavy productions of the year nothing like an adequate quantity of new work is forthcoming, the difficulty of making vessels built at prevailing prices anything like remunerative in this year of beggarly freights proving the greatest obstacle to business. All this points in one direction. The action of English North-East Coast employers in taking steps to reduce almost the only important element in the cost of production it is in their power to deal with, must be followed, or what little new work there is in the market will assuredly go elsewhere. Of the few orders booked during the month probably the most important was that which went to Pointhouse. Messrs. A. and J. Inglis secured an order from the Anglo-American Oil Co. Limited for a petroleum-tank steamer similar to that recently contracted for by Messrs. Dunlop, Port-Glasgow. Messrs. William Denny Brothers, Dumbarton, are to build a new paddle steamer for the London, Woolwich and Clacton Steamboat Company. The new vessel is to be of the same type as the celebrated "Clacton Belle," but of larger dimensions and greater speed. A steel sailing ship of 3600 tons deadweight is to be built by Messrs. Robert Duncan and Co., Port-Glasgow, for Mr. R. R. Paterson, Glasgow; and two small steamers, one for an English firm and the other for Glasgow owners, by Messrs. J. Gilmour and Co., Irvine. There were launched from Scotch shipbuilding yards 27 vessels of 26,487 tons, of which 16, representing 5476 tons, were steamers, and 11, measuring 20,011 tons, sailing vessels. To the total the Clyde contributed 14 steamers of 3930 tons, and 7 sailing vessels of 13,129 tons; the Forth, a steamer of 1500 tons, and 3 sailing vessels of 3982 tons; the Tay, a sailing vessel of 2900 tons; and the Dee, a trawler of 46 tons. The sailing tonnage, it will be observed, again greatly exceeds the steam both in the Clyde return and in that for the East Coast. The production of last August was 22,733 tons.

A New Enamelling Process.

MONS. P. H. BERTRAND, of Paris-Grenelle, who last year invented a new magnetic oxidising process for the prevention of rust on cast iron—a method which, by the way, is being successfully exploited by himself in Paris and by Mons. Henri Morel, at Revin, Ardennes,—has just commenced to work a new enamelling process which he has devised, and for which certain success is claimed. As an apparent proof of its value it may be mentioned that the Société du Val d'Osne, the principal ornamental casting manufacturing concern in France, has adopted Mons. Bertrand's methods, and has obtained the monopoly of the sale of art castings treated by the new process, a number of which, we understand, are to be shown at the forthcoming exhibition at Chicago. The imitation of the most variegated marbles by the artist is said to be perfect, the illusion being absolute. Mons. Bertrand, who appears to enamel cast iron, wrought iron, and steel with equal facility, accumulates shade upon shade, delicately blends them, and sets them in skilful opposition. Apart from these enamels du luxe, he produces more ordinary enamels which, he says, can be sold at a very cheap price. The French technologist, while maintaining the details of his new processes strictly secret, claims to have effected a revolution in the ancient art of enamelling.

A VALUABLE discovery of white clay, very rich in alumina, has recently been made near Cleveland, Queensland. Some excellent specimens of pottery have already been made from this clay, and a quantity has been shipped to England.

Hydraulic Machinery.—X.

FIG. 28 shows an arrangement of balanced lift as made by Messrs. Waygood and Co., of London. The principle is the same as the direct-acting lift, with the exception that a balance arrangement is introduced. In all direct-acting lifts the ram must be made large enough to lift the weight of parts + the load, and the former

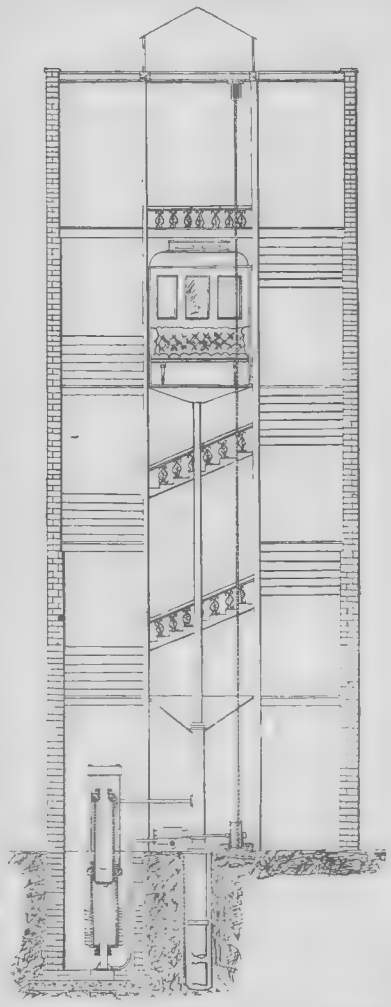


FIG. 28. HYDRAULIC MACHINERY. FIG. 30.

quantity, which in large lifts is considerable, is practically lost. Again, with high lifts and a high pressure it may be necessary to make the ram larger than required to lift the weight of parts + the load, so as to resist flexure, and the loss of pressure water becomes still greater. The balanced hoist overcomes both these difficulties, and will be best understood by reference to the diagram, Fig. 29. A and

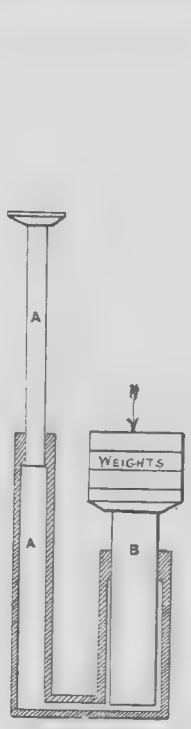
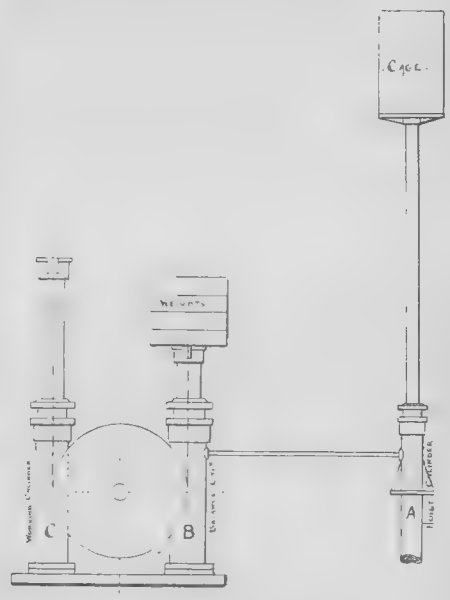


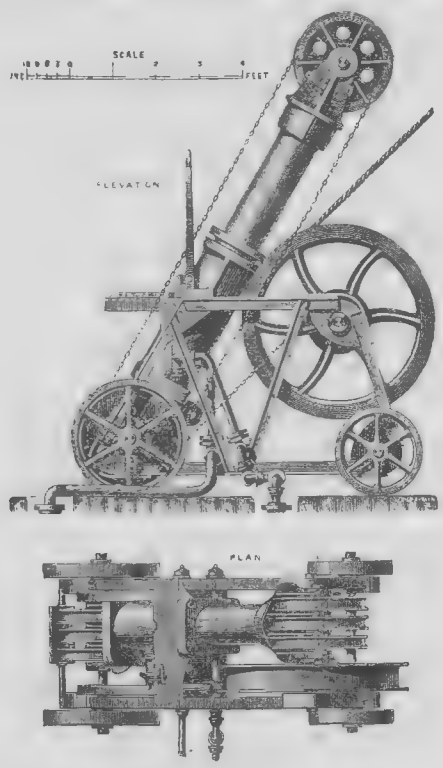
FIG. 29.

B are two cylinders of equal capacity in communication with each other. A is the hoist cylinder, and we will assume that its ram has been designed so as to be strong enough when fully loaded to resist flexure, and that it is connected by a pipe with cylinder B. Weights are now placed on B so as to balance the ram and cage in cylinder A, a sufficient preponderance being allowed so that A will always lower freely and raise the weighted ram B. The ram A, it will be observed, has been designed to carry the load as a column, totally independent of the pressure per square inch on it. We have now, therefore, to divide the load + the preponderance by the area of the ram A, which will give the pressure per square inch on ram B that must be added by the working cylinder in the direction of the arrow in order to work the hoist. In Fig. 28 A and B are in communication and are never exhausted. When the hoist is at the top of its stroke the ram A is down, and *vice versâ*. The cylinder C is the working cylinder, and is actuated by the valve D. On pressure being admitted to C the ram A is forced down, and the ram B rises. When C is open to exhaust the preponderance of weight in B causes A to rise again, and B to lower. Several modifications of the balance arrangement are in use. One of these is shown in Fig. 30, and is that patented by Messrs. Richmond and Co. The notation in the Fig. is the same as in the previous case, and needs no explanation. It is specially adapted for London use, where it is often difficult to obtain head room for the other types.



Another type, in which the weights are altogether abandoned and the balancing entirely done by water pressure, is also much used, a constant-pressure cylinder being substituted in place of the weights.

Other purposes for which hydraulic power hoists have been used are coaling and canal lifts, the former being largely in use at Cardiff and Bute Docks. The most important of the latter are the Anderton lifts to



HYDRAULIC MACHINERY.—FIG. 31.

connect the River Weaver with the Trent and Mersey Canal, the difference in levels being 50ft., and the total weight lifted 1050 tons, and the La Louvière lift on the Canal du Centre, France. Portable coaling hoists lifting loaded trucks weighing 20 tons are also in use at Cardiff. A portable jigger hoist is shown in Fig. 31, and is much used on quays and at docks for unloading light goods from ships. It consists of a lifting cylinder with multiplying sheaves, fixed at an angle on a portable frame. One end of the lifting chain is fixed to the cylinder and the other to the small barrel on the drum shaft. The load is lifted by means of a rope leading from the larger barrel and thence over the yardarm of the ship. The valves are either worked by means of suitable ropes from the ship's deck or from the platform of the jigger itself.

(*To be continued.*)

Notes on a Problem in Water Power.

(*Concluded from page* 94.)

TURNING now to the other type of wheels, but little known in this country except on the Pacific Coast, the impulse class, and assuming that the force of spouting water is equal to its gravity, less an inconsiderable friction in orifices, the question arises, Why has not the evolution of waterwheels followed on this line, instead of pressure, for all except low heads?

This is a very important question, one that may well engage the attention of this society, and one that calls for explanation such as will be by no means easy or apparent. It is true that with that class of impulse wheels called "undershot," and some other cruder forms operating by the impulse of spouting water, the efficiency attained has been so low as to lead to the conclusion that the losses were inherent in the method or mode of operation; and this opinion has, it seems, become general, without anyone very closely inquiring into the matter.

That the efficiency of tangential wheels driven by impulse is as high as can be attained by pressure turbines has been proved by numerous experiments here, also by some recent tests at Holyoke, Mass., and is beyond controversy. It has long been settled on this coast, and as a problem no longer exists. No one here would expect under a head of 50ft. or more to attain with any known type of pressure waterwheels a higher efficiency than is given out by tangential impulse wheels; but this state of opinion and practice is confined to narrow limits now, and is the more to be wondered at when we consider the rapidity and completeness of investigation in other branches of dynamic engineering at the present day, especially when the economic and constructive conditions so much in favour of the impulse type of waterwheels are taken into account. These we will now consider in a brief way.

There is a wide difference between a waterwheel driven by impulse and one operating on the pressure system. The first cost of the former, for a given power, is one-half as much, and its maintenance is still less, in proportion.

Figuratively speaking, when a wheel is changed from the pressure to the impulse system it is taken out of its case and mounted in the open air in plain sight. All the various inlet fittings are dispensed with, and are replaced by a plain nozzle and stop valve. Its diameter is made to produce the required rotative speed, whatever that may be. The shaft and its bearings are divested of all strains except those of gravity and the stress of propulsion when the water is applied at one side only. Most important of all, there are no running metallic joints to maintain against the escape of water, no friction and no leaks; there are, indeed, no running joints or bearings whatever, except the journals of the wheel shaft.

The effect of grit and sand is eliminated, both as to vanes and bearings, and there are no working conditions that involve risk or call for skill. If a vane is broken another one is applied in a few minutes' time. If a large or small wheel is wanted the change is inexpensive and does not disturb the foundations or connections.

Capacity is at complete control; the wheels can be of 10, 100, or 1000 H.P., without involving expensive special patterns. The speed of rotation is not confined to commercial dimensions because of patterns or other causes. It is merely a matter of choice with the purchaser or maker.

Now, granting the efficiency of impulse wheels, which, as before remarked, can hardly be called in question for all heads exceeding 50ft. or even 30ft., and conceding the constructive and operating advantages just pointed out, the question at first named arises, Why has the evolution of waterwheels during fifty years past been confined to the pressure class? also, Why has it been proposed at Niagara Falls to employ pressure turbine wheels under a head of 100ft. or more, when the conditions point to the better adaptation of open, or impulse wheels?

It is not necessary in such an inquiry to discuss the problem of horizontal and vertical axes, or other local conditions, in the case of the Niagara plant, or in any other case, further than to say that the pressure class of wheels offer no advantages not balanced by equal or greater disadvantages, as will no doubt appear if there should be discussion of this subject before the society.

Besides the object of this communication first named, there is the further one of calling the attention of the members present to the impulse or open waterwheels so extensively employed on this coast, and to suggest that, if possible, they manage to see such wheels in operation under various heads, especially under high heads. In observing a machine of any kind in motion, there are impressions gained which cannot be conveyed by description; but I warn every one against inference from this remark that the tangential water motor wheels on this coast are not scientifically understood and treated. The problems involved may not be so many or so intricate as in the case of pressure turbine wheels; and this is fortunate, because the literature of the latter is one of much perplexity to any but skilled mathematicians, and for that reason has not been of so much use as it ought to have been in developing the wheels.

In this country—and it is a most commendable thing to mention—the pressure turbine, by an inward flow, or an inward draught, has been greatly simplified in construction, cheapened in first cost, and at the same time better adapted to impure water, without losing anything in efficiency. I believe the inward-flow turbines made by the Risdon Company at Mount Holley, New Jersey, have in public tests on more than one occasion shown an efficiency as high, or even higher, than the more finely fitted Fourneyron and Jonval types.

The record of American engineers in this branch is one of which they may well be proud; and now that impulse wheels of the Girard type have made much progress abroad, and have here in California been modified much as the Fourneyron and Jonval wheels have been in the Eastern States, it is quite time that more attention was bestowed upon them in other parts of the country. The analogy in the two cases is marked. By an inward flow American makers reduced the running parts, or the wheel proper, of pressure turbines to a small diameter, increasing its speed accordingly. This lessened the weight and cost of the wheels in the proportion of their diameters, and at the same time dispensed with the accurate fitting involved in the outward and downward-flow turbines; and this, as before said, has been done without sacrificing efficiency.

The tangential type of open wheels has been similarly dealt with here in California. The running water joints have been wholly dispensed with. The construction has been cheapened one half. The round jet has been applied in the most simple manner, with an increased dynamic effect, and the efficiency attained is believed to be more than is reached by the finest examples of Girard wheels in Europe.

Conceding these statements and facts brings us back again to the query forming the subject of this communication—namely, Why has the evolution of waterwheels followed on the line of *pressure* instead of *impulse?*

A Large Search Light.

FOR some weeks Mr. L. H. Rogers, of the Thomson-Houston Electric Company, has been engaged in the installation of a huge search light on the top of Mount Washington, U.S.A., and in making preliminary experiments to ascertain the penetrating power of the beam of light sent out from that high altitude. Some definite results have just been obtained which are certainly remarkable. The distance between the source of light and Portland, Me., in a direct line is about 85 miles, yet telegraphic signals sent by means of the light were easily observed and interpreted by Weston Union operators located on the roof of the company's office in that city. Direct telegraphic communication was established between the operator of the light on Mount Washington and the observer at Portland, so that the interpretation of the signals could be sent back for verification to the operator at the lamp. The beam of light was directed at an angle of 45 degrees above the air line between the two stations, in order to avoid low-lying clouds. This would make the beam of light at the point observed directly above the city of Portland, not far from 80 miles distant from the observer, and the distance in a direct line from the summit of Mount Washington to the point at which the light was visible, not far from 110 miles. The experiment was reported as entirely successful. The observer read the signal sent by the beam of light easily and accurately, as there were no clouds to interfere with the view.

The Construction and Efficiency of Boilers of Locomotive Engines.

(*Continued from page* 78.)

ABOUT three years ago Mr. F. W. Webb, M. Inst. C.E., introduced an ingeniously-designed firebox on the London and North-Western Railway. It is made of two cylindrical steel chambers joined by a rectangular neck. The bottom chamber is in two pieces, which are joined by a flanged seam; the front half is cylindrical, whilst the back half has the plate flanged out to receive the covering plate of the upper chamber, the two being joined by a lap joint. The upper portion of the box is built in three rings, which are joined by continuous flanges, forming ribs for strengthening the firebox; the centre piece is cylindrical, whilst the front length, which forms a combustion chamber, is of D section,

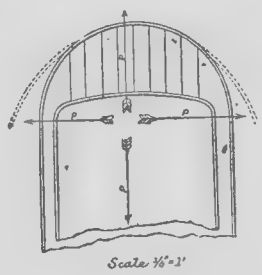


FIG. 8.

giving a large space for pitching the centres of the tubes. The ends of the chambers are made with annular corrugations, which add to the elasticity and strength of the plates. Very few water-space stays are required in this firebox, and thus a considerable saving is effected.

Mr. J. C. Park, M. Inst. C.E., has for the last two or three years used stays of soft basic steel in place of copper for fireboxes on the North London Railway. After being screwed into place, the ends of the stays are forced slightly outwards with a drift, which is applied to holes drilled up the centres. These steel stays are considerably cheaper than copper, both in material and labour, and sustain a longer series of deformations from expansion and contraction without failing. In connection with the use of steel stays, a point which should not be overlooked is that if the water space between the firebox and the shell be limited to 2½in. or 3in., these stays form a rather too rigid attachment; and owing to the upward expansion of the firebox, which in large boilers rises nearly ½in. towards the top, they have to suffer a severe bending stress. If these stays are to be used with success in large fireboxes, having heating surfaces of 90sq. ft. or more, the water space should commence from 3in. at the foundation ring, and taper to about 6in. or 7in. at the top of the firebox. This will allow the stays, which should be turned down slightly at the centres, to adapt themselves to the expansion of the firebox, and prevent them from breaking. Many boilers give trouble through broken firebox stays, such accidents being entirely due to the limited water space between the firebox and shell.

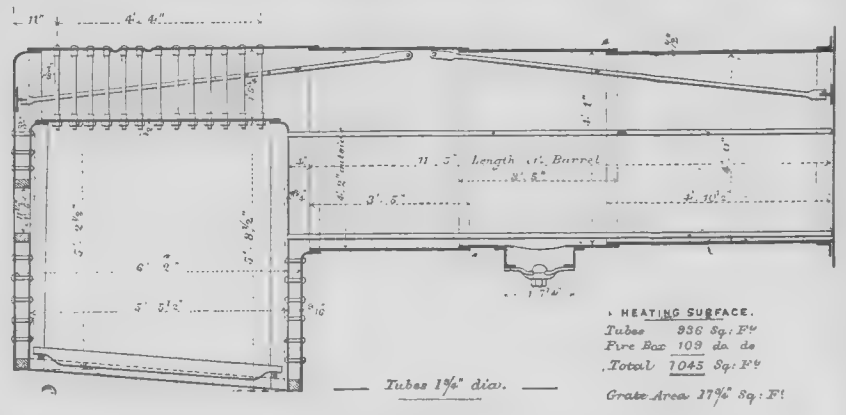


FIG. 7.

A departure from the ordinary boiler practice on the Great Northern Railway was made by Mr. P. Stirling, M. Inst. C.E., 22 years ago, who dispensed with the steam dome, deeming it to be unnecessary and a source of weakness to the boiler. The standard express boiler on this railway (Fig. 7) has a telescopic barrel built in three rings, ½in. thick, 4ft. 2in. in external diameter at the firebox end, and 4ft. at the smokebox end. The barrel is 11ft. 5in. long, the circumferential seams, which have laps 2½in. wide, are single riveted, and the longitudinal seams are double riveted with inside and outside butt strips. In place of longitudinal through stays there are four gusset stays 1¼in. in diameter, pinned to angle irons at the back end tube plate and at the centre of the boiler. When it is considered that in the majority of locomotive boilers there are from ten to twelve through stays supporting the boiler longitudinally, there appears to have been in this case a marked difference of opinion as to the amount of longitudinal staying necessary for a boiler.

The author considers that with the use of these gusset stays the introduction of diagonal stress cannot be beneficial to a circular ring, which is in perfect equilibrium under internal pressure; and that as the centre ring of the barrel has to transmit the longitudinal stress due to the pressure on the flat-end plates to the point of attachment of these stays, there is a tendency to distort the centre ring from a circle. The roof of the firebox is rigidly attached to the shell by 112 direct stays ⅞in. in diameter; the ends of these stays are "jumped" to 1in. in diameter for a length of 2in. They are screwed into the shell and through the copper box, and are fastened by hexagonal nuts underneath, whilst the upper ends are cold-riveted to the shell.

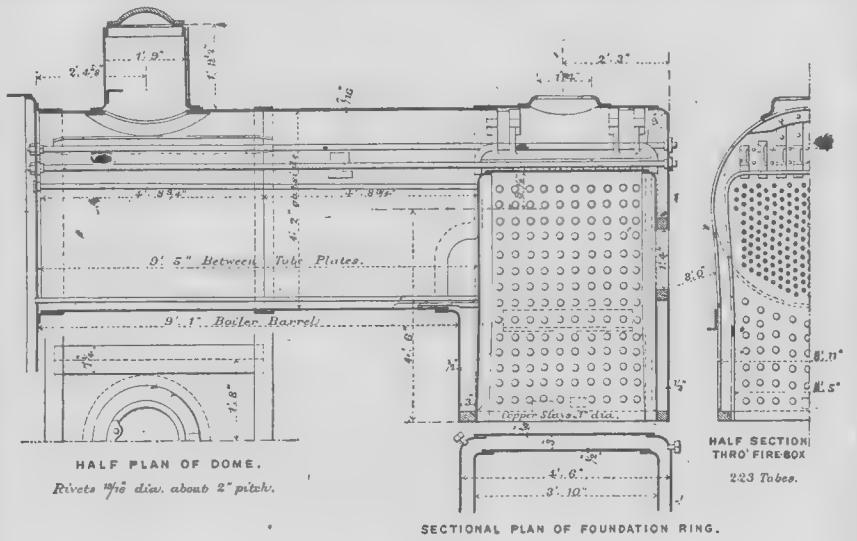


FIG. 9.

There are several grave objections to this method of rigidly fixing a large firebox, and the advantages of girder stays are at once apparent. With the use of the latter, the stress on the upper part of the shell is similar to that in a cylindrical barrel of the same diameter, equilibrium being maintained by the tension in the side plates of the shell, due to the downward pressure on the top of the firebox and the foundation ring. If, as in this boiler (Fig. 8), direct stays are used, the upward and downward pressures are at once balanced, leaving the horizontally resolved parts of the pressures to come into equilibrium by the distribution of stress in the upper part of the shell, and increased tension of the upper rows of water-space stays. The result is a tendency in the circular shell to distort into a parabolic form, encouraging grooving and corrosion, and necessitating a thicker covering plate if the shell is in three pieces; or, in the case of an entire shell, stiffening bars riveted round the curve. Mr. Stirling, in his latest design of boiler, has placed two girder stays transversely at the front of the firebox. These stays rest upon angle irons riveted to the sides of the shell, the other part of the firebox being rigidly attached as before. The consequence is, the relieved portion is free to expand until the steam pressure in the boiler puts the firebox and shell into equilibrium, resulting in a constant bending stress on the copper covering sheet between the last row of rigidly attached stays and the expanding portion, which will in time create a groove across the entire width of the firebox.

The argument often advanced that direct stays are cheaper than girder stays is of doubtful validity. When a firebox attached to the shell by riveted direct stays is renewed, the whole of the stays are cut away, owing to corrosion and wasting through the burning of the stay ends projecting through the firebox. Moreover, a serious item in the expense of making direct stays is due to the fact that the ends are either jumped, or the whole of the stays are turned down. Then the cold-riveting must be considered; and, further, the last two rows of stays on each side of the box piercing the shell at an acute angle have, as a rule, only half the holding power of the stays at the centre. The only form of firebox shell suitable for direct stays is that known as the Belpaire firebox, which has the covering sheet of the shell made flat on the top, so that the two flat surfaces of the firebox shell and firebox are equi-distant, and the direct stays are of equal length. In this case it is advisable to increase the tensile resistance of the stays by placing nuts on the ends instead of riveting them. The Belpaire firebox is not much employed in England, although its use is general on the Continent. The heating surfaces in the boiler (Fig. 7) are fairly proportioned, the ratio of cylinder capacity to grate area being up to the average. There are 174 tubes 1¾in. in diameter, 2⅜in. pitch, giving a heating surface of 936sq. ft., that of the firebox being 109sq. ft. The area of the firegrate is 17½sq. ft. The boiler supplies steam to cylinders 18in. in diameter and 28in. stroke, which, neglecting clearance, give a ratio of 5·574 cubic in. of cylinder capacity to 1sq. in. of grate area, 1 cubic in. of cylinder capacity to 9·45sq. in. of tube-heating surface, and 1 cubic in. of cylinder capacity to 10·6sq. in. of total heating surface.

Fully recognising the economy of standard work, Mr. J. Holden, M. Inst. C.E., has introduced on the Great Eastern Railway a neatly-designed boiler, which is applicable to both express and goods engines. The plates of the shell and barrel are steel. The boiler barrel, which is 10ft. long and 4ft. 4in. in outside diameter, is built in three rings ½in. thick, and butt strips 5in. wide by ⅜in. thick cover the circumferential seams, which are single-riveted on each side of the joint, making the barrel a true cylinder. Girder stays of a heavy section support the firebox to the shell. There are eight of them, the four centres ones being slung from the roof of the shell by means of hoops, which rest on 1½in. pins passing through the angle irons. The author believes that several of these boilers have lately been fitted with Mr. Holden's well-known petroleum-refuse burning apparatus. In the boiler there are 256 tubes 1⅝in. in diameter, and 2⅛in. pitch. The heating surface of the firebox is 105·5sq. ft., that of the tubes being 1124·96sq. ft.* The grate area is 17·9sq. ft.

* Attention may be here drawn to the difference in boiler practice existing on English railways. Whilst the Great Northern standard boiler supplies steam to a combined cylinder capacity of 14,246 cubic in., as compared with the Great Eastern boiler giving steam to a combined cylinder capacity of 12,211 cubic in., the latter boiler has 188·2sq. ft. more heating surface than the former.—G. H. S.

This boiler supplies steam to cylinders 18in. in diameter and 24in. stroke, giving a ratio, neglecting clearance, of 4·72 cubic in. of cylinder capacity to 1sq. in. of grate area, 1 cubic in. of cylinder capacity to 13 25sq. in. of tube-heating surface, and 1 cubic in. of cylinder capacity to 14·5sq. in. of total heating surface. A further illustration of Mr. Holden's practice is a small steel boiler for tank engines used for suburban traffic. This is shown in Fig. 9.

(*To be continued.*)

The Cost of Pumping Water.

THE difference in the cost of pumping water, by the various methods of supplying it, such as injector, vacuum pump, steam pumps and power pumps, is approximately as follows:—Where the amount of water pumped is equivalent to 33,000ft.-lb., or 1H.P.; By injector, inspirator, jet pump and such devices, the amount of steam required will be that obtained from the use of 100lb. of coal of average quality. By vacuum pumps, 67lb. of coal will be required to furnish the steam. With small steam pumps, such as are in ordinary use for feeding single boilers, 25lb. of coal. With large steam pumps, which are proportioned to the work, 13lb. of coal will furnish the steam for the amount of work mentioned. With power pumps, when driven by an engine, the amount of coal will be that required to develop 1H.P. by the engine plus the friction of gearing. This will vary from 2lb. to 4lb. of coal. With a power pump, driven by water wheel, the cost will be that of maintaining the power. With a power pump driven by an electric motor, the cost will be that of the electric energy delivered at the motor, which will vary according to the conditions.

Shipbuilding Notes.

Messrs. John Reid and Co. Limited launched on the 30th ult., from their yard at Whiteinch, a screw steamer of about 600 tons. The machinery will be fitted by Messrs. Kincaid and Co. Limited, Greenock.

On the 2nd inst. there was launched by Messrs. John Fullerton and Co., from their yard at Paisley, an iron screw steamer of 400 tons, built to the order of Messrs. J. and J. Hay, Glasgow. The compound engines will be fitted by Messrs. Muir and Houston, Portman-street, Kinning Park.

The new screw steamer "Grange," which has been built for the Carron Line by Messrs. Wigham, Richardson and Co., of Newcastle, went on her trial trip on the 30th ult. The trial was highly satisfactory. The vessel is 280ft. in length, by 36·2in. in breadth, with a tonnage of 1517, and is 4000H.P.

On the 27th ult. Sir Raylton Dixon and Co. launched, from their No. 2 dockyard at Middlesbrough, two steam trawlers of the following dimensions:—Length over all, 107ft. 8in.; beam, 20ft. 5in.; depth moulded, 11ft. 8in. The engines, with cylinders 16in. and 32in. diameter, by 22in. stroke, will be fitted by the North-eastern Marine Engineering Company, Sunderland.

On the 27th ult. the steamship "Warrnamboot," from the yard of the Sunderland Shipbuilding Company, went for her trial trip off the coast. This vessel has been built for Mr. William Lund, of London, and is intended for his Australian service. Her engines, which were built by Messrs. Wigham, Richardson and Co., gave a speed of 12½ knots, and were in every way satisfactory.

There was launched on the 30th ult., from the shipbuilding yard of Messrs. Schlesinger, Davis and Co., Newcastle-on-Tyne, a steel screw steamer named the "Pandora," built to the order of a London firm. Her length is 121ft., beam 23ft., and depth 8ft. 7in. The engines have been constructed by Messrs. Hedley and Boyd, of North Shields, and are of the compound type, with cylinders 13 and 26in. diameter, with a stroke of 16in.

The tank steamer "El Gallo," built at the Walker shipyard of Messrs. Sir W. G. Armstrong, Mitchell and Co., was taken to sea for her trial trip on the 1st inst. The "El Gallo" is of the following dimensions:—Length, 170ft.; breadth, 28ft.; depth moulded, 15ft. She has a deadweight carrying capacity of about 800 tons. The engines are of the triple-expansion type, manufactured by the Wallsend Slipway and Engineering Company, and on trial a speed of about 10 knots was attained.

Owing to the depression in the shipbuilding trade, and the difficulty experienced in securing new orders, Messrs. Sir Raylton Dixon and Co., of Middlesbrough, will before long close their No. 2 shipyard. So soon as the vessels now on the stocks are completed, every hand in the yard will be dispensed with. It is expected that the vessels in course of construction will be completed in a month or six weeks. Until quite lately the yard employed about 500 or 600 men.

On the Applications of Electricity in the Royal Dockyards and Navy.

(*Concluded from page* 79.)

3.—TORPEDO AND GUN CIRCUITS.

Torpedo Circuits.—When the Whitehead or fish torpedo was first adopted as an element in the offensive armament of ships of war, it was ejected from its carriage by means of an impulse rod or piston actuated by compressed air. The ejection was effected by opening a communication valve between the impulse cylinder and a reservoir of compressed air. As it was necessary that the discharge of the torpedo should be effected from an observing and directing station remote from the torpedo itself, electricity was early pressed into service for effecting the communication between the observer and the firing valve; and in 1879 an electrical arrangement was first fitted for enabling the firing valve to be opened from a distance. The method of ejecting torpedoes from a carriage by means of an impulse rod was soon abandoned, however, and the air-gun principle took its place. By this method the torpedo is itself placed in a tube or gun, into which compressed air is admitted behind the torpedo; and the ejection is effected by the expansive force of the air acting directly upon the rear of the torpedo, exactly as the explosive force of gunpowder drives a shot out of a gun. When worked from a distant point the firing valve was still opened by electricity, but on an improved plan.

In the earlier ships the batteries were placed below the water-line, and the circuits were complete with main and return wires. Where not protected by armour or not below the water-line, the wires were duplicated and kept apart from each other, as greater security against both circuits being destroyed at one time from the same cause. The circuits now used are earth circuits, and are duplicated where exposed—as, for instance, near the torpedo tubes. The standing wires of the modern circuits are lead coated. The conductor is formed of a strand of seven wires of No. 22 legal standard wire-gauge, or 0·028in. diameter. It is insulated with indiarubber, which again is covered with three servings of cotton tape prepared with indiarubber. The enclosing lead tube is covered with a strong tape saturated with a water-proof mixture. Where flexible leads are required, they are formed of 36 wires, each of No. 30 legal standard wire-gauge, or 0·012in. diameter, insulated as before with indiarubber and cotton tape, and protected by a binding of hemp. The whole is saturated with Hooper's composition.

Within the last few years powder impulse has been introduced for discharging torpedoes. For this purpose a cartridge containing a small charge of gunpowder is placed in a powder chamber prepared for it at the rear of the torpedo tube. The cartridge is fired by means of an electric current generated in a local circuit—that is, by a battery secured to the torpedo tube itself. This local circuit is momentarily completed by the action of the firing circuit from the observing station.

Gun Circuits.—Electricity is further employed in the navy for effecting the discharge of guns, either individually at the gun positions or simultaneously in groups, from some protected observing station. So far as the writer is aware, this system was first practically employed about 1874, and the current was obtained by means of pile batteries. These were formed of about 160 elements, consisting of alternate copper and zinc plates, separated by fearnought (a kind of flannel) dipped in diluted vinegar. With these batteries high-tension fuses were used, which were not only dangerous, but frequently failed owing to the difficulty of keeping the circuits free from moisture. From 1874 down to about 1881 gun circuits were fitted as complete wire circuits. Now, earth return circuits are adopted, except in some cases of auxiliary circuits which are still complete wire circuits.

Safety Arrangements.—These are highly necessary in the ordinary working circuit, in view of the possibility of the gun being fired prematurely with possibly disastrous results. For instance, the gun might by mischance be fired before the breech block was properly replaced and locked; and to avoid this danger the circuit is broken automatically by the act of unlocking the breech, and the connection is again made automatically in the act of relocking after loading. Again, the gun might be fired after the breech block was secured, but before the gun was run out, in which case the energy of recoil would be expended in smashing up the gun mounting. To avoid this the circuit is automatically broken at the front end of the carriage by the action of recoil, and is remade automatically just as the gun again reaches its run-out position. The making and breaking of the circuits are effected by means of rubbing contacts; and while these give assurance against an accidental discharge of the guns, they are not an unmixed good, as they sometimes cause a missfire; a continuous protected circuit without any of these breaks would be more certain and reliable.

In the earlier turret ships, especially in the rigged ones, the guns were masked by portions of the ship's structure at certain angles of training. In such cases devices were introduced for automatically breaking the firing circuit at these particular angles. In all the later turret and barbette ships, the turrets or barbettes are placed near the extremities of the ship; and while having a limited arc of training, they are unobstructed in their fire throughout the whole of this arc when the ship is cleared for action. Consequently there is now no necessity for any safety arrangements. In the modern as in earlier ships the full depression of the guns cannot be obtained throughout the whole horizontal arc of training; the danger of firing into the deck is obviated by an ingenious automatic arrangement, which is in connection with the hydraulic or other mechanism for working the guns, and has nothing to do with the electric circuits.

4.—ELECTRIC COMMUNICATION.

The efficiency and safety of a modern warship are largely dependent upon the means of communication between the various working parts of the vessel. The officer directing from the conning bridge the movements of the vessel must have the means of instantly transmitting to the engine-room a few prearranged signals with regard to the starting, stopping, etc., of the engines; and he likes to have the signal transmitted back to him to assure him that his order has been correctly received and is about to be carried out. When manœuvring in squadrons, in which his ship has to keep her correct station in relation to the others, he must be able to communicate to the engine-room his orders regarding small variations of speed, say one revolution more or less over a considerable range of speed. He also likes to be able to ascertain for himself on the bridge the actual revolutions of the engines; and he prefers to do this at a glance, without having to take the trouble to use a watch and count the revolutions, say, for a minute. When the steering-wheel is immediately under his own eye, as it generally is when steam or other mechanical power is applied for steering the ship, he likes to have an indication on the bridge that the rudder is properly responding to the motions of the steering wheel. Should either of the alternative steering positions below have to be resorted to, he requires a certain means of communicating his orders to the steersman at that position. In addition to the means of transmitting a few prearranged signals, he also requires a means of conversing from the conning bridge with the engine-room, with the steering positions, and with a few other places. In action, when the vessel's movements may be directed from a protected conning station, he needs, in addition to the foregoing requirements, to be put in communication with the officers at the various gun quarters, including turrets or barbettes, and also with those at torpedo-discharging positions, etc.; in fact, he requires to be placed either directly or indirectly in communication with every part of the ship where officers and men are stationed. Where only a few prearranged signals are required, these intercommunications are effected by means of transmitting and receiving instruments, either mechanical or electrical; while for communications of a general character voice pipes are employed.

About six years ago many complaints were received from ships as to the unsatisfactory nature of the means of signalling and intercommunication; and as many new instruments, chiefly electrical, were then being proposed for use in the navy, a committee was appointed, consisting of naval officers, naval constructors, and marine engineers, of which the writer was a member, to inquire into and report upon the whole subject. In the course of the inquiry the views of a large number of representative naval officers were obtained, in order to determine, firstly, what intercommunication was necessary and best for a ship of war. On this primary question naval officers were not wholly agreed; but there was sufficient accord to enable a standard method to be laid down. In order to arrive at the best means for effecting these intercommunications, the committee studied all the methods that had been previously tried, including those in use in the mercantile marine. They carefully examined and tested many new instruments that were submitted to their notice, and carried out a number of independent experiments.

Voice Pipes and Call Bells.—Among other means of improvement, the committee recommended that all voice pipes connecting stations where there is noise or vibration, and all others if they are over 100ft. in length, should be increased from 1¼in. internal diameter, the size then in use, to 2in. internal diameter, and that with these larger pipes a system of electrical call bells should be fitted. This plan is now generally carried out in the navy, and has resulted in greatly improving the means of communication. The call-bell arrangement consists of an ordinary pushboard at the sending station with the well-known annunciator or drop shutter instrument at the receiving station; the dropping shutter indicates the station from which the call has come, and therefore the particular pipe to be spoken through. It is found that with voice pipes communication to places where there is much vibration or noise is not very satisfactory. Many devices have been and are still being tried with the object of improvement.

The committee were much impressed with the immense facilities offered by an electrical system of communication, and amongst other things telephones of different forms were tried in substitution for voice pipes. The results were not such as to lead to their introduction into the ships of the navy.

Telegraphs.—With regard to instruments, though for ship work a mechanical system has some great advantages over an electrical, yet as a means of establishing communication between these instruments at distant stations the electrical system is far and away the best. The many disadvantages of a system of shafting and bevel wheels, led through a considerable portion of the length of a ship, scarcely need to be stated, while the great facilities offered by a simple insulated wire are equally self-evident. The committee therefore recommended that the one mechanical telegraph for communicating orders from the bridge or conning tower to the engine-room should be retained, but that the telegraph for orders respecting speed of revolution should be electrical. Many of these electrical telegraphs have been fitted in the navy, but the reports upon them have not been uniformly favourable, although in some instances they have been highly so. Whether the grounds for the unfavourable reports have always been good and sufficient is a matter of opinion; but at the present time electrical telegraphs in the navy appear to be somewhat under a cloud, so that the field is still open for invention in this direction. The telegraphs already in use are worked by primary or secondary batteries, while a new form has been proposed, to be worked direct from the ship's dynamo.

5.—OTHER APPLICATIONS OF ELECTRICITY.

Submarine Mines.—There are some other applications of electricity in the naval service which may be referred to without any detailed description. One important application is that to submarine mining, whereby stationary torpedoes or mines are exploded by an electrical current from an observing station on shore, after the position of an enemy's ship in relation to the mines has been ascertained by means of range-finding instruments in two observing stations at a considerable distance apart, but electrically connected.

An electrical apparatus has also been designed and experimented with for enabling a boat, without any person in it, to be sent from a safe distance into an enemy's mine-field, to explode and thus render harmless the mines laid there. By this apparatus the boat can be steered, the engines stopped or started, and the countermines dropped where desired and exploded. In this way an otherwise exceedingly risky operation can be performed without danger to life; and the worst casualty that can happen is the loss of the boat only.

Night Signalling.—Electricity is also applied to night signalling. The ordinary semaphore instrument as used by day is illuminated at night by means of incandescent lamps in front of a reflector, the whole being contained in a wooden box placed a short distance in front of the semaphore arms, which are painted white in order to make them more distinctly visible by night in the rays of the electric lamps. Another system of night signalling has lately been introduced, consisting of four flashing lamps placed in a vertical line at topmast head. The lamps are incandescent, with special filaments, and one lamp or more can be

switched off at will by an arrangement of switches in the chart-house, where there are also four small lamps which follow the movement of the lamps at masthead. By a preconcerted code the combinations of the lamps are interpreted. This arrangement is intended principally for squadron sailing at night, to convey orders as to altering course, speed, etc.

Gun Sights.—The sights for guns are now adapted for night firing by employing electricity for their illumination. This is effected by means of small incandescent lamps, for which the current is obtained from a primary battery consisting of three Leclanché cells in a box secured to some part of the gun mounting. A switch is also fitted for each sight, having a resistance connected with it, so that the current can be varied at will, and thus the lights can be made more or less brilliant to suit circumstances.

Examination of Gun Bores.—An apparatus is now supplied to ships for examining the bores of guns. It consists of an inclined mirror supported in a metal frame, which is made to fit the bore, and can be pushed into any part of the bore by a long rod screwed into it. According to the size of the gun the frame carries from one to four 100C.P. lamps, which illuminate the bore, and by the aid of the inclined mirror a close examination can be made for defects.

Motors.—The application of electricity to motors has not yet gone very far—not so far, in fact, as in some other nations it has already gone or is now going. Of the success of its application to the working of guns, supply of ammunition, etc., the writer is not very sanguine; but if results prove satisfactory the navy will no doubt quickly profit by the experience of other nations. Electrical science is as yet in its infancy, and it promises enormous developments in the near future, so that in a few years operations may be performed by electricity which are not dreamt of now. In any case the British Navy will not fail to press into its service every development of science which will increase the efficiency of the nation's first line of defence.

Electric Locomotives: Some Results in Actual Working.*

THE object of the present communication is to place on record the performances of two electric locomotives, the most powerful of their kind, which were supplied at the end of last year by Messrs. Siemens Brothers and Co. to the City and South London Electric Railway.

In the year 1888 the company, then called the City of London and Southwark Subway, issued a specification asking, among other things, for electric locomotives capable of developing a maximum of 100 brake horse-power. Owing to financial considerations the contract was not placed with Messrs. Siemens Brothers and Co., although a perfect agreement had been arrived at on the technical points of the question.

The City and South London Company, however, invited Messrs. Siemens Brothers and Co. again in the beginning of last year to tender for locomotives in accordance with a specification practically identical with that agreed upon in 1888, and as a result two electric locomotives have been built and are now working.

TABLE A.

Speed in Miles per Hour.	Electrical H.P. put into Motor Armature.	Electrical H.P. put into Motor Magnets.	Total Electrical H.P. per Motor.	Total Electrical H.P. per Locomotive.	Brake H.P. measured.	Efficiency per cent.
12·25	56·93	2·8	59·76	119·52	110	92
14·77	24·42	1·21	25·63	51·23	47·1	91·87
15·7	21·5	0·86	22·36	44·72	40·2	89·89
17·83	21·85	0·74	22·59	45·18	42·62	94·32
22·73	29·23	0·35	29·58	59·16	54·3	91·79
21·7	19·5	0·2	19·7	39·4	36·6	92·68
30·6	23·27	0·17	26·44	32·88	43·76	92·19

Each locomotive carries two motors, and the use of all gearing is obviated by winding the armatures of the motors on the axles of the wheels of the locomotive. This method of construction was illustrated by a model shown at work at a meeting of the Society of Arts on May 18, 1881, and had been first suggested by Sir William Siemens, who at the time of his lamented death was actively preparing a proposition to work the Metropolitan Railway by electric locomotives.

The motors for the two locomotives were tested before they were fitted into their places by means of a Prony brake, and some of the results of this first set of tests are given in Table A.

Since the two locomotives have been set to work on the railway they have had to keep the same time as the others, so that their full power cannot be utilised; but it has been found that their efficiency is satisfactory in every respect.

Observations of the current and E.M.F. have recently been made simultaneously, by taking sets of readings on the ammeters and voltmeters, both at the generating station and on the locomotive. From these observations several sets of curves have been plotted. At the time these observations were made the locomotives had run about 8000 statute miles, and on all four motors the brushes were wearing at the rate of about ¼in. per 1000 miles run, this small wear being a consequence of the motors running sparkless and practically without heating.

TABLE B.

—	Watt Minutes.	Ampère Minutes.	Total Time, including Stops.	Mean Volts.	Mean Amperes	A.
			Min. Sec.			
Stockwell to City.						
Locomotive No. 15: Journey 1.....	322,630	768·65	14 10	419·7	52·41	13·05
,, No. 15: ,, 2.....	291,935	689·33	14 16	423·6	48·34	13·27
,, No. 16: ,, 1.....	317,640	733·32	14 40	433·2	50·00	13·29
,, No. 16: ,, 2.....	315,660	751·32	14 50	420·15	50·60	13·41
Mean.....	311,988	735·65	14 36	424·15	50·33	13·25
City to Stockwell.						
Locomotive No. 15: Journey 1.....	323,665	763·05	15 30	422·5	49·42	12·19
,, No. 15: ,, 2.....	312,945	737·93	15 26	424·1	47·83	12·58
,, No. 16: ,, 1.....	305,320	717·99	15 8	425·2	47·46	13·21
,, No. 16: ,, 2.....	321,660	749·31	14 53	429·25	50·19	12·83
Mean.....	315,910	742·83	15 15	425·26	48·72	12·7
Final mean	313,949	739·24	14 55	424·71	49·52	12·97

A. Average running speed, miles per hour exclusive of stops.

An examination of the curves shows that there is no similarity whatever between those representing the volts at the generating station and those on the locomotives respectively. This is, however, easily explained by the consideration that the volts at the generating station are influenced by all the trains in motion at the same time, while the volts on each locomotive are principally influenced by the demand of the locomotive itself.

When the train is started the current is regulated by the driver, so as not to exceed a certain amount, by means of switches inserting resistances into the main circuit; but these resistances are cut out within half a minute of starting, so that the waste of energy in the resistances is kept as low as possible.

Each locomotive, fully equipped, weighs 13½ tons, and the weight of the train of carriages it has to draw is about 21 tons. To this the weight of the passengers has to be added.

A summary of the results is given in Table B, which shows that the average power developed by each locomotive requires a current of not more than about 50 ampères, although in starting as much as 140 ampères are required.

This fact illustrates at the same time the peculiar difficulties which have to be grappled with in the construction of such locomotives, which have to work under conditions almost diametrically opposite to those of generating dynamos in electric-supply central stations.

* Paper by Alexander Siemens, read before the British Association at Edinburgh.

Steam v. Hot-water Heating.

IN order to determine whether steam or hot water was the best for heating greenhouses, a series of experiments have been made at the Agricultural Experiment Station in connection with the Cornell University (New York, U.S.A.), in which the following conclusions were arrived at:—(1.) The temperatures of steam pipes averaged higher than those of hot-water pipes throughout the entire circuit for the entire period of test. (2.) The higher the inside temperature in steam pipes the less is the proportionate warming power of the pipes at a given point. The heat is distributed over a greater length of pipe, and as steam is ordinarily carried at a higher temperature than hot water, it has a distinct advantage for heating long runs. (3.) When no pressure is indicated by the steam gauge, the difference between the temperatures of the riser and the return is greater with steam than with hot water. (4.) Under pressure the difference is less with steam than with hot water. (5.) There is less loss of heat in the steam risers than in the hot-water risers, and this means that more heat in the steam system is carried to the farther end of the house and more is spent in the returns as bottom heat. (6.) This relation is more uniform in the steam risers than in the hot-water risers, giving much more even results with steam than with hot water. (7.) When the fires are operative the fluctuation in the temperature of the risers at any given point is much greater with hot water than with steam. (8.) An increase in steam pressure raises the temperature in the entire circuit; but the temperature does not rise uniformly with the pressure. (9.) The first application of the pressure increases the temperature of the returns much more than that of the risers. (10.) Steam is better than hot water for long and crooked circuits. (11.) Pressure is of greater utility in increasing the rapidity of circulation of steam and in forcing it through long circuits and over obstacles. (12.) Unfavourable conditions can be more readily overcome with steam than with hot water. (13.) Hot water consumed more coal than steam, and was at the same time less efficient. This result would probably be modified in a shorter and straighter circuit with greater fall. (14.) Under the conditions here present, steam is more economical than hot water and more satisfactory in every way, and this result is not modified to any extent by the style of heaters used.

Catalogues, Price Lists, Etc.

Engineers, Tool Makers, Metal Merchants and others are invited to forward Catalogues, Pamphlets, Circulars, Price Lists, etc., for notice in this column.

THE GASEOUS AND LIQUID FUEL SUPPLY COMPANY LIMITED, 25, Market street, Manchester, have issued a catalogue of scientific appliances for effecting the economic combustion of fuel for all industrial purposes. The patents described include Mr. B. H. Thwaite's gaseous-fuel system for annealing steel castings, heating bars for steel melting, calcining and roasting minerals, drying clay, and for chemical purposes. In the company's oil-firing system the oil is converted into gas before it is consumed, and its own combustion effects gasification. When exceedingly high temperatures—say from 3000° to 4000° F.—are required, the company employs Mr. Thwaite's continuous recuperative furnace, which is in successful operation for various purposes. Illustrations and particulars are also given of oil injectors, oil-fired forges, safety oil-storage tanks, etc.

From Mr. ALFRED HAWORTH, 19, South John-street, Liverpool, we have received a specimen of his patent expanding and self-binding book cover or paper file. This is an ingenious arrangement which enables one to readily bind journals, newspapers, letters, invoices, price lists, circulars, etc. It possesses the advantages of expanding to suit the depth required, and at the same time holds its contents firmly and securely. The back of the case resembles a book, while any of the contents can be readily extracted and replaced. No springs, screws, pins, or paste are used, and the whole arrangement is very neat and convenient.

The WOODRUFF KEYING COMPANY LIMITED, Bank-street, Manchester, have sent us a large sheet illustrating the various applications of their method of keying. Also a copy of a neat pamphlet containing particulars of the machines used in connection with the system. We have on a previous occasion described the Woodruff system in detail, and need now only remark that it continues to be received with increasing favour by tool makers, machinists, etc.

From the SMITH AND VAILE COMPANY, 16, Mark-lane, London, we have received a very complete catalogue of the Smith and Vaile duplex pumps, which are applicable to the various requirements of the engineer. Several illustrations are also given of duplex hydraulic pressure pumps, independent air pumps and condensers, power pumps, etc. Some useful tables and hydraulic data are also given.

Trade Notes.

The Lincoln Wagon and Engine Company announce an interim dividend at the rate of 5 per cent.

It has been decided to blow out the two remaining furnaces at the Tredegar Iron and Steel Works.

The directors of Mushets Limited recommend a dividend of 4s. per share for the year ending June 30.

The Northern Electric Wire and Cable Manufacturing Company Limited, Halifax, have declared a dividend of 7½ per cent.

Messrs. John Abbot and Co., Park Works, Gateshead, have secured an order for 7000 tons of pipes for the Newcastle Water Company.

The Austrian Tyre Works have contracted to supply the Austrian State Railways with 20,000 tons of wheel tyres yearly for a period of four years.

Messrs. J. Wallace and Co., of Dundee, have received an order from the Dundee Police Commissioners for 73 tons of tramway rails, and 11 tons of fixings.

Messrs. G and J. Weir, Holm Foundry, Cathcart, have secured the contract to supply 12 sets of pumps and 4 evaporators and heaters to each of the new Cunarders now in course of construction.

The tenders of Messrs. Stewart and Co., of Glasgow, for the pipe contract, and the Glenfield Company, of Kilmarnock, for the valve contract for the Dowanpatrick Waterworks, have been accepted.

Messrs. R. H. Barnett and Co., electrical engineers, of Volt Works, Walker Gate, Newcastle-on-Tyne, have obtained the electric-light contract for the West Hartlepool Co-operative Society's new premises.

It is stated that there is not the slightest foundation for the report published in Vienna that it is the intention of Messrs. Krupp, the well-known gunmakers, to establish works at Ekaterinoslav, in Russia.

Messrs. Daniel Adamson and Co., engineers, Dukinfield, Manchester, have just completed the erection of a couple of large engines at the newly-erected flour mills of Messrs. James Tucker, East Bute Dock, Cardiff.

Messrs Priestman Brothers, of Holderness Foundry, Hull, have successfully put to work one of their oil engines in the underground workings of Messrs. Brooks and Pickup's Waterloo Main Colliery, near Leeds.

The Admiralty have instructed Messrs. Wm. Simons and Co., of Renfrew, to construct another powerful hopper dredger for use at Portsmouth Harbour. This will be the fourth hopper dredger which this firm has constructed for the Admiralty.

The directors of Babcock and Wilcox Limited have decided to recommend that the following dividends be paid for the half-year ended 30th June last—viz., at the rate of 6 per cent. per annum on the preference shares, and at the rate of 15 per cent. per annum on the ordinary shares.

Messrs. L. Sterne and Co., of the Crown Ironworks, Glasgow, have received an order to make two refrigerating machines for the Cunarders now building at Fairfield, while Messrs. Hocking, Glascodine and Co., of Liverpool, are supplying two of their 4000-gallon patent fresh-water condensers for the vessels.

Mr. James Oldham, Old Dock Patent Piston Works, Newport, Mon., informs us that his piston business is now amalgamated with that of Messrs. John Watts and Co., of the Broad Weir Engine Works, Bristol, and that the manufacture of Alexander Oldham's patent metallic piston and air pump bucket packings will in future be carried on in conjunction with the general engineering business, under the style of Watts and Oldham Limited, at the Bristol works.

The Cleveland ironmasters' returns for August show the largest production of pig iron of any month this year—viz., 213,000 tons, 111,000 tons being hematite and basic, and the remainder Cleveland iron. The whole stock of Cleveland iron is now 46,000 tons, a decrease of nearly 5000 tons upon July. This is a smaller stock than during the stoppage produced by the Durham strike, before which the stock stood at 286,000 tons. There are 86 furnaces in blast, three more than before the Durham strike.

Wheel cutter in metal only. Every description of gearing. R. CHIDLAW, 43, City-road, Manchester.

Having regard to the enormous circulation of THE MECHANICAL WORLD, the Editor suggests that it is by far the best medium for the insertion of every kind of "Wanted" advertisement, and the price is only one halfpenny per word. The Editor will be glad if MECHANICAL WORLD readers will kindly bear this in mind as occasion arises.

Recent Improvements in Mill Engines.

THE illustrations herewith show some improvements which have lately been introduced by Messrs. John Musgrave and Sons Limited, Bolton. Fig. 1 is a sectional view of Crompton's packing box and metallic packing, which, as will be seen, is of a very simple character. The piston rod is surrounded by a loose sleeve extending the whole depth of the ordinary packing space, the inner end of this sleeve resting on springs, which compensate for variations in length through expansion and contraction; the outer end of the sleeve bears against the bottom of the packing box containing the metallic packing. The packing box is held against the loose sleeve by a cover-plate bolted to the packing flange. The cover-plate bears on a flange encircling the packing box, and while making a steam-tight joint at this point, it does not prevent the packing box from moving sideways in following the movements of the piston rod; and in horizontal engines, through wear or lack of alignment, the piston rod is sometimes much higher at one end of the stroke than at the other end. The piston rods of vertical engines are also liable to be out of line from the same causes, but not to the same extent as those of horizontal engines.

The packing consists of rings of white metal of a triangular section, each ring being in halves and placed in the box so as to break joints, a final layer of asbestos packing being inserted at the top and against which the gland bears. The packing may be readily applied to any existing engine, as no change or alteration of arrangements is required, with the exception of the addition of two or three studs to the packing flange of the cover. Figs. 2, 3, and 4 show Buckley's patent piston-rod support, Figs. 2 and 3 giving views partly in section, and Fig. 4 showing the application of the support to the piston rods of a compound tandem engine.

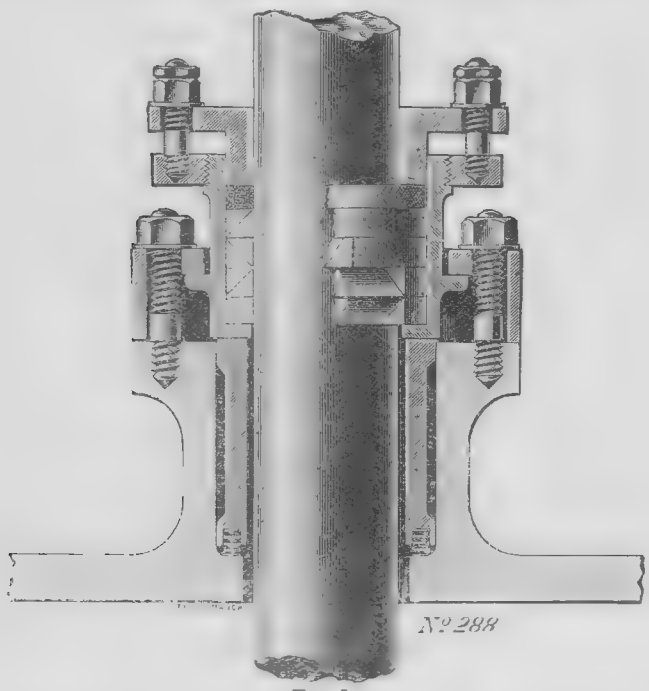


FIG. 1.

compound engines, supports may be arranged at both ends of the large cylinder, and at the front end only of the small cylinder. These supports may be easily adjusted so as to keep the pistons central in the cylinders, preventing wear on the bottom, and keeping the glands and packing boxes in good order, at the same time the friction of the engine is greatly reduced.

In Fig. 5 is shown Musgrave's patent traversing Corliss valve, which, although not of recent introduction, is deserving of the attention of those who experience trouble with valves of this type owing to grooving. This action is prevented by the above device, which causes the valve to move longitudinally across its seat so that it never makes two succeeding strokes in the same place, thus greatly reducing the wear and preserving both seat and valve.

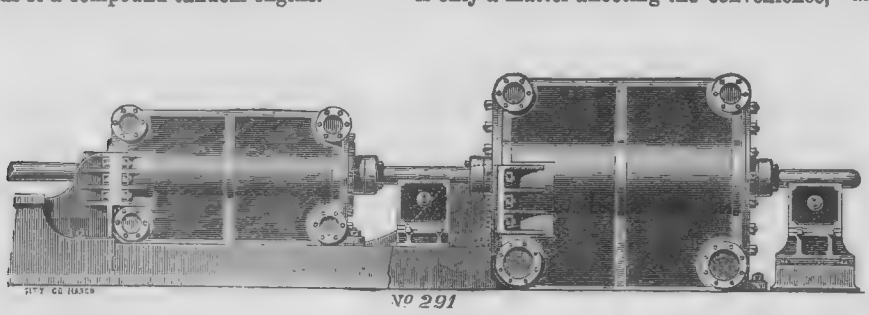


FIG. 4.

IMPROVEMENTS IN MILL ENGINES.

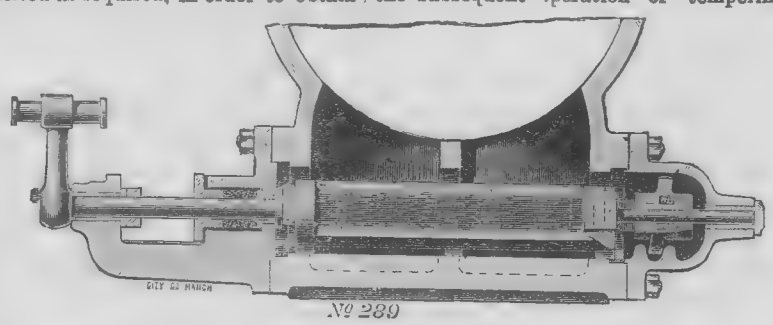


FIG. 5.

Hardening Steel.

FOR ordinary purposes it is safe to say that the best results in hardening steel tools and other articles of this material are obtained from the use of pure soft water as the cooling medium. There are many so-called "improved" processes, consisting of baths composed of various mixtures, for which more or less superiority over the old-fashioned method is claimed. As a rule, however, their merits are more imaginary than real, as a fair comparison with water would demonstrate. Water has, among other advantages, that of cheapness; consequently it may be changed as often as necessary to keep its temperature very little above normal. Where brine, acidulated water, or any of the various mixtures are used, it often becomes necessary to suspend operations in order to give the bath time to cool down sufficiently to impart the required degree of hardness to the steel. This, of course, is only a matter affecting the convenience, and would not be considered a serious objection were the results, as regards quality of the work, superior to those obtained from the use of clear water. The latter medium, however, may safely be considered the standard, and all other methods should be rated in comparison with it.

Still, there are special effects resulting from the use of some of the mixtures which cannot be obtained from pure water; and frequently the former are employed for that reason. For instance, solutions of salt brine, sulphuric acid, and sal ammoniac have the effect of cleansing from the film of scale usually unavoidable where the heating is done slowly, which is the only way to obtain the proper uniformity of temperature throughout the entire mass of the article. Oils are employed almost universally for hardening such articles as do not require, either primarily or permanently, the full degree of hardness of which the steel is capable; and in many classes of work of this character the subsequent operation of drawing the temper is entirely dispensed with. Of course this would not be possible for articles requiring a fine temper, but for such as it is suitable for it effects considerable saving of labour, and, consequently, of cost.

When the highest possible degree of excellence of temper is necessary, it can only be obtained by slow, uniform, and careful drawing, from full hardness. If it is desired to gauge the temper by colour, the particular tint or shade due to the desired degree of hardness will not be a reliable guide unless the primary hardening be thorough. The use of mercury as a hardening bath—though long known—is not universally nor even extensively understood, and even were the results from its use entirely satisfactory, it is doubtful whether it would ever come into general use, on account of the expense of the metal. The process, however, does not give any better quality of work than can be obtained from water—that is, as ordinarily used,—and it may be questioned whether the advantage would not prove to be decidedly in favour of the latter.

A very simple and inexpensive modification of the process has been discovered, the effect of which is very marked—surprising, in fact,—and more particularly so as the means employed would seem wholly inadequate to produce such a result. Of course, where the highest degree of perfection is attained it can only be through great care and skill in the manipulation, both in heating and cooling; and this, added to a thin coating of borax, and the mercury cooling bath, constitutes the process. For all fine work a clear flame from a charcoal fire is always preferable to blacksmith's coal. Great care must be exercised to prevent an excess of air from the blast, as otherwise the oxidising action is very rapid and causes scaling, as well as deterioration in the quality of the steel. The use of a charcoal fire admits of the work being in plain sight during the entire heating, and it can, therefore, be turned and shifted as required, in order to obtain perfectly allowable, while without the borax the limit would be the traditional "cherry red." To ensure perfectly uniform heating in all portions of the article it should be maintained at the required temperature for a sufficient length of time to allow a "soaking" or equalising action, and immediately upon this point being assured the work should be quickly withdrawn from the fire and plunged into the mercury. It is of the utmost importance, says the "Iron Age," that the immersion be prompt and complete, and that the work be kept constantly moving about in the bath in order to prevent the local heating of the mercury and a consequent formation of mercurial vapour, which would interpose a film between the steel and liquid metal, and by preventing actual contact interfere with the rapidity of transmission of the heat of the steel into the mercury. Also, the article must be kept continuously in the bath until its temperature and that of the bath have become very nearly equalised, as, should its withdrawal be premature, there is not only a loss of the full possible degree of hardness, but the danger of warpage and even breakage is imminent.

While the result of failure to comply with these necessary precautions will almost invariably be a complete failure, their careful observance will ensure a quality of work which may almost be said to defy comparison with any other known method. The steel comes from the bath perfectly free from oxide or scale—due, of course, to the protection from atmospheric contact by the coating of borax. If any of the latter substance still adheres, its removal is easily effected. Occasionally some portions of the surface are coated with mercury, apparently by amalgamation; but it, also, is readily removed. The most highly finished articles may be hardened in this manner, and their polished surfaces come from the bath intact, except as to having assumed a whitish colour.

But the most remarkable result is in the great strength and hardness of the steel. By all other known processes extreme hardness is always attained at the expense of strength—that is, the greater the degree of hardness the more brittle under a breaking strain will it become. Strange as it may seem, however, by the process under consideration the strength and hardness appear to increase alike, and therefore the subsequent operation of tempering, except where a very low degree of hardness is required, becomes unnecessary. To illustrate the superiority of the results obtainable by this process, a very simple demonstration will suffice, and cannot fail to convince the most sceptical.

From a bar of ordinary carbon tool steel about $\frac{3}{4}$in. square cut off two pieces, each about 6in. or 8in. long, and from these make (by grinding or filing, but without forging) two gravers such as are used for hand turning. As the desired quality in such tools is hardness only, the tempering process is always omitted. Harden one of the gravers by the ordinary water process, and the other by the mercury and borax.

It has frequently been urged as an objection to horizontal engines, that the weight of the pistons and rods would wear the cylinders oval, and leakage of steam past the pistons would result from this uneven wear; also, from the same cause, the ordinary packing boxes and glands used would wear out of round, necessitating constant attention and frequent renewals of packing, to keep the glands steam-tight. The arrangement shown is for the purpose of furnishing an efficient support to the piston rod close to the cylinder, and the makers find, after extended experience, that it answers admirably for this purpose. For single-cylinder or side-by-side

After hardening they should be ground on a wet grindstone, and a keen edge given by an oilstone. The diamond-shaped faces forming the ends of the tools should be fairly smooth, as it is the most convenient surface on which to make the test. Place the mercury-hardened tool in the vice, with the diamond face in a horizontal position, and, grasping the other firmly in both hands, place the point against the face of the first, using all the pressure possible; then push, slowly and firmly, and endeavour to cut a groove in it. The result will be failure, try as often as you will. Either the fine point of the attacking graver will snap off, owing to its want of strength, or it will be dulled and blunted, like a piece of soft steel. Now, reversing the operation, let the attack be made by the mercury-hardened tool on the face of the other, and a clean groove and corresponding chip will be cut from it without any serious damage to the aggressive point, though, of course, it cannot stand it indefinitely. If the test be repeated, it will invariably give the same result, provided the mercury-hardening has been properly done.

Another convincing test is that of drilling. This will demonstrate not only the hardness, but also the wonderful strength imparted to the steel, which in the case of the graver test is not nearly so marked. Take an ordinary flat drill — say about $\frac{5}{16}$in. diameter—and harden it carefully, after forging a new point to ensure against cracks or flaws from previous use. Grind (wet) the angle of face about 60° with relation to the axis. The angle of clearance back of cutting edge should be very flat, to give the greatest strength to resist the strain of cut. Place the drill in a heavy-geared drill press, or, preferably, a back-geared lathe, as the latter is much stiffer than a drill press, and any appreciable amount of springing or yielding under the strain is fatal to any attempt to drill hardened steel. Put the lathe on slowest speed in gear, and all is ready for the test. About as convenient a test-piece as possible is an old file—say about half worn, to make sure that its full hardness has not been impaired. This should be placed against the drill point and forced up solidly against it by means of the dead spindle; then start the lathe and feed up, by main strength, or the only effect will be to dull the drill. If the manipulation is correct the drill will cut the hard steel, the chips falling in the shape of fine needles, the full length of cutting edge of the drill, and a clean, true hole can be made entirely through the file. When it is considered that a great increase is necessary in the hardness of the drill over that of the material to be drilled, it will be appreciated that the hardening by this process must be of exceptional character. Also, that the tremendous strain supported by the point of the drill at starting the hole—when the full power of the operator must be applied to ensure its cutting—gives evidence of the strength imparted to the steel.

By way of comparison, let the same drill with which the file has been drilled be annealed and rehardened and tempered as for ordinary shop use. Try then to drill, say, a saw blade, which is soft enough for easy filing. If it cuts at all it will only be for a few revolutions, when it will begin to "squeak," and finally refuse to cut. Now reharden to full hardness, and try to drill the saw. It will cut, so far as mere hardness is concerned, but will fly to pieces immediately it gets fairly to work, being as brittle as glass.

As to the causes of the peculiar effects from this method of hardening, be they chemical, physical, or both, there does not appear to be any very satisfactory explanation. Of course the greater thermal conductivity of mercury as compared with water, notwithstanding its much lower specific heat, will account for a more rapid cooling of the steel, and as the change of molecular structure of the steel will be dense in proportion to its rapidity, it would seem that this point was sufficient to account for the result. But this hypothesis is untenable, from the fact that the use of the mercury bath alone does not give the result, and it is only obtained when the former is used in connection with the borax treatment during heating. A microscopic examination of the structure, as shown in a fracture, reveals a very marked difference between the two methods, and even under the naked eye the peculiarly fine grain of the mercury-borax specimen allows of its being readily distinguished. However, while the cause may be problematic, the effect is not so, and therein lies its principal importance.

MEM. FOR ADVERTISERS.—The charges for advertisements in THE MECHANICAL WORLD are less than half those of any other engineering journal in proportion to circulation, and not one-eighth the price of some of its competitors.

The Design and Construction of Stationary Engines.—XXXIII.

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Back Guides and Tail Rods.—With horizontal engines having a stroke of more than ordinary length, it is the practice of some makers to prolong the piston rod through the back cylinder cover, this part of the rod being termed the "tail" rod. When thus arranged the rod not only transmits the load, but is made to carry the weight of the piston and thereby helps to reduce the wear on the bottom of the cylinder. Sometimes the rod merely passes through the stuffing box, as in Fig. 160, a cover or shell being bolted to the stuffing-box gland as a protection. This cover is generally turned and polished all over. This plan is not a very good one for supporting the rod, as the weight very soon wears away the necks of the glands. It is more usual to attach a sliding shoe or slipper to the end of the tail rod, which works in a planed guide placed behind the cylinder. This guide is very similar in form to that used for the centre slipper crosshead, except that, where the rod is merely required to be supported and does not drive any mechanism, such as the air pump, it has no top cover plates. The guide is generally made a separate casting, bolted to the back cover, either by a suitable target end or by means of a flange on underside of the stuffing box, the opposite end being supported on a pillar or stool, as in Fig. 161.

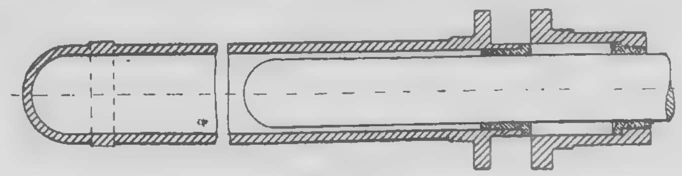

FIG. 160.

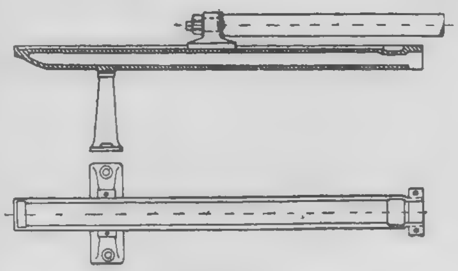

FIG. 161.

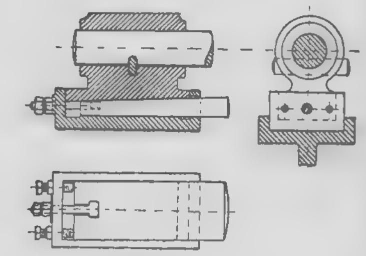

FIG. 162.

In some engines the guide is in the form of a long stool bolted to the foundation separately. Fig. 162 shows an adjustable slipper for the back guide, which can be adjusted for height.

Fig. 163 shows a form of back guide adopted by some Continental makers, and Table XIX. gives the leading dimensions for a number of sizes of engines from 24in. stroke upwards. The guide, it will be seen, is formed with a target end bolted to the cylinder cover. The cover having a slight projection entering into the opening in the target end, this ensures a perfect centring of the guide with the cover being obtained. In large engines it is desirable to fix the cylinder cover first and then attach the guide thereto by the studs, as shown. The guide is supported near the back end, sometimes on an ornamental column or stool, as shown, bolted to the foundation.

TABLE XIX.—DIMENSIONS OF BACK PISTON ROD GUIDES.

Length of Stroke.	in. 24	in. 26	in. 28	in. 30	in. 32	in. 34	in. 36	in. 38	in. 42	in. 46	in. 48	in. 50	in. 51	in. 60	in. 72
A	12 1/4	13 3/8	14 3/16	15	15 3/4	16 1/8	16 15/16	17 3/4	18 7/8	20 1/2	21 5/8	22 1/2	24	26 3/8	30 3/4
B	11	12 1/8	12 7/8	13 1/2	14 1/4	14 9/16	15 1/4	16	17	18 7/16	19 17/32	20 1/4	21 21/32	23 3/4	27 9/16
C	7	8 1/4	8 1/4	8 7/8	9 1/8	9 3/8	9 7/8	10 5/8	11 13/16	12 1/4	13 3/8	14 3/16	15	16 15/16	20 1/2
D	9	10 1/4	10 1/2	11 1/4	11 7/8	12 1/4	12 5/8	13 3/8	14 3/8	15 3/8	16 3/8	16 5/8	18 3/8	20 1/4	24
E	12 3/4	14	14 3/4	15 3/4	16 17/32	16 15/16	17 3/4	18 1/2	19 11/16	21 1/4	22 7/16	23 5/8	25 3/16	25 9/16	31 7/8
F	3 1/4	3 3/4	3 15/16	4 1/8	4 3/8	4 1/2	4 3/4	4 15/16	5 3/8	5 15/16	6 1/8	6 1/4	6 13/16	7 1/4	8 1/2
G	2 1/8	2 3/8	2 9/16	2 3/4	2 15/16	2 15/16	3 5/32	3 3/8	3 3/4	3 15/16	4 1/8	4 3/8	4 3/4	5 1/8	5 7/8
H	1	1	1 3/16	1 3/16	1 3/16	1 3/8	1 3/8	1 3/8	1 9/16	1 3/4	1 3/4	1 15/16	1 15/16	2 1/8	2 1/4
I	4 15/16	5 1/2	5 3/4	6 1/8	6 1/4	6 1/2	6 7/8	7	7 5/8	8 1/4	8 5/8	9	9 1/2	10 3/8	12 1/4
J	2 3/4	3 1/8	3 3/8	3 9/16	3 3/4	3 3/4	3 15/16	4 1/8	4 1/2	4 15/16	5 1/8	5 3/8	5 3/4	6 1/4	7 1/4
K	2 3/16	2 3/8	2 5/8	2 9/16	2 9/16	2 3/4	2 15/16	2 5/16	3 5/32	3 3/8	3 9/16	3 3/4	3 15/16	4 3/8	4 15/16
L	Dependent on the diameter of piston rod approx. = 1·2 dia. of rod.														
M	3/4	3/4	3/4	3/4	7/8	7/8	7/8	7/8	7/8	15/16	15/16	15/16	15/16	1	1 1/8
N	1 1/8	1 1/4	1 3/8	1 3/8	1 9/16	1 9/16	1 9/16	1 3/4	1 3/4	1 15/16	2 3/16	2 3/16	2 3/8	2 9/16	3 1/8
O	1 3/4	1 3/4	1 15/16	2 9/16	2 3/8	2 3/8	2 9/16	2 3/4	2 15/16	3 1/8	3 1/2	3 1/2	3 3/4	4	5
P	1 1/2	1 5/8	1 3/8	1 3/8	1 9/16	1 9/16	1 9/16	1 3/4	1 3/4	1 15/16	2 3/16	2 3/8	2 3/8	2 1/2	3
T	1	1	1 1/8	1 1/8	1 3/16	1 3/16	1 3/8	1 3/8	1 3/8	1 1/2	1 1/2	1 1/2	1 3/4	1 3/4	2
R	8 1/4	8 7/8	9 1/2	10 1/4	10 3/4	11	11 3/4	12 1/4	13	14	14 3/4	15	16 1/8	17 3/4	21 1/2
S	3/4	3/4	3/4	1	1	1	1	1 1/8	1 1/8	1 1/8	1 3/16	1 3/16	1 1/4	1 1/4	1 3/8
W	2 1/8	2 1/8	2 3/8	2 3/8	2 1/2	2 1/2	2 3/4	2 3/4	3	3	3 3/8	3 3/8	3 1/2	4 3/8	5 1/2
X	9/16	9/16	5/8	5/8	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	7/8	7/8	7/8
Y	2 1/8	2 1/8	2 1/8	2 3/8	2 3/8	2 1/2	2 1/2	2 3/4	2 3/4	3	3	3 5/32	3 3/8	3 9/16	4 1/8
Z	31 1/2	33 7/8	36 5/8	39	41 3/4	44 1/8	46 7/8	49 1/4	54 3/4	59 3/8	61 13/16	64 9/16	69 3/4	77 1/8	91 3/4
a	5 1/8	5 1/2	5 29/32	6 1/4	6 11/16	7	7 1/2	7 7/8	8 21/32	9 1/2	9 3/8	10 1/4	11	12 1/4	14 9/16
d	20 7/8	22 7/16	24 1/4	25 3/4	27 9/16	29 5/32	30 29/32	32 1/2	35 1/8	39 3/16	40 3/4	42 13/32	45 7/8	50 13/16	60 7/16
f	3/4	3/4	7/8	7/8	7/8	7/8	1	1	1	1 1/8	1 1/8	1 1/8	1 1/4	1 1/8	1 1/4
						Number		of	bolts						
g	4	4	4	4	4	4	4	4	4	4	4	4	4	6	6
h	5/8	5/8	5/8	3/4	3/4	3/4	3/4	7/8	7/8	7/8	1	1	1	1	1 1/8
k	3 1/8	3 3/8	3 9/16	3 3/4	3 15/16	4 1/2	4 3/4	4 15/16	5 3/8	5 11/16	6 1/4	6 1/2	6 7/8	7 1/2	9 1/8
l	5 1/8	5 1/4	5 29/32	6 1/4	6 11/16	7 1/16	7 1/2	7 7/8	8 21/32	9 7/16	9 3/8	10 1/4	11 1/32	12 7/32	14 9/16
m	8 11/16	9 1/4	9 3/4	10 7/16	11	11 5/8	12 1/4	13 3/8	14	15	16 1/4	17	17 1/2	19 1/4	22 3/8

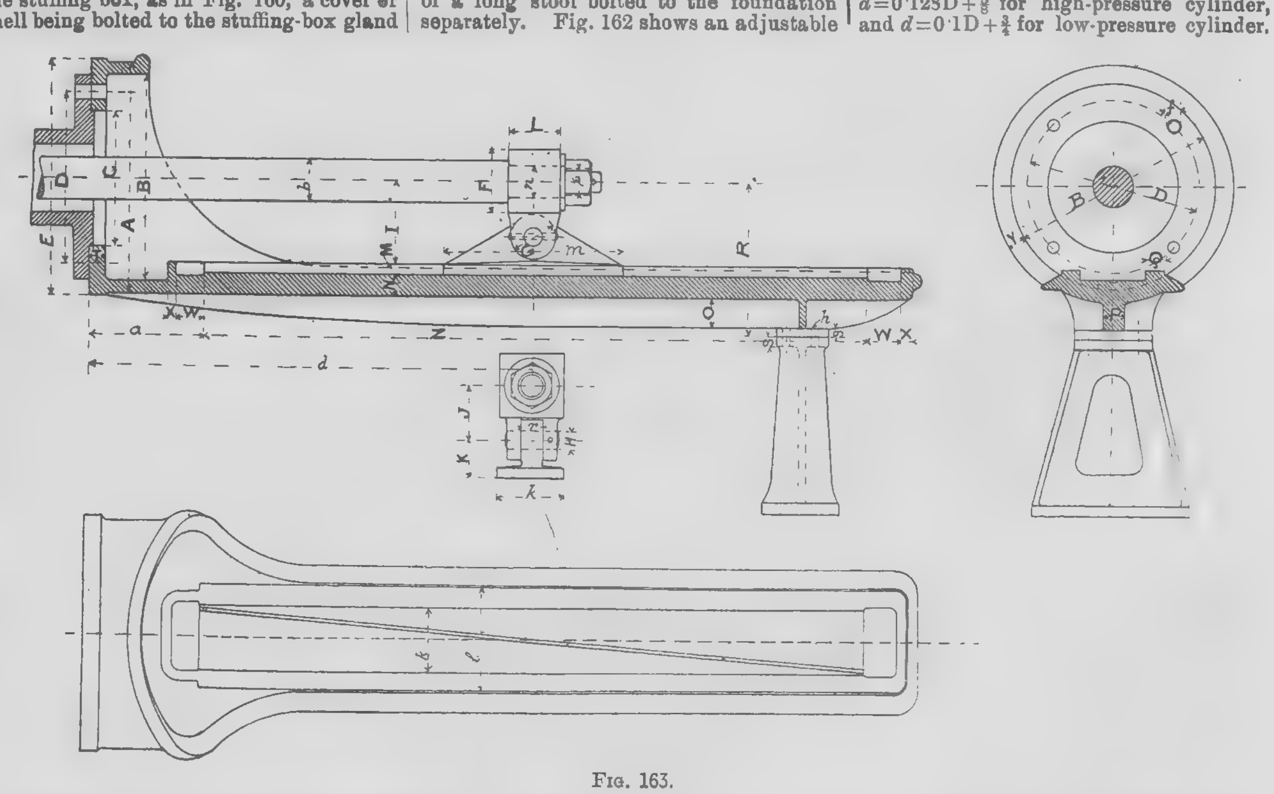

FIG. 163.

To keep the slipper and guides well supplied with oil, recesses or pockets are cast at each end, over the edge of which the slipper passes, picking up the oil as it returns. Sometimes light brass tips are fitted to the ends of the slipper, which dip in at each end and carry the oil over. A diagonal groove is placed lengthwise of the slide to retain the oil also. In order to prevent the sliding shoe from binding through any bending of the rod, the connection between the shoe and the rod is made in the form of a joint, with a double jaw on the socket on the rod end secured by a turned pin to the slipper, as shown. The dimensions of these guide frames are proportioned to the stroke, not to the diameter of the cylinder. In the table the dimension L depends on the diameter of the piston rod, and column *g* gives the number of bolts in the cylinder cover.

The end of the rod which goes into the slipper is made slightly conical, and is secured by means of a nut. The average diameter of this cone is given as = 0·5 piston rod diameter, and the diameter of the screw $p = 0{\cdot}4$ piston rod diameter.

The piston rods are usually made of steel, not only on account of their greater stiffness, but also on account of the finer grain of steel permitting of a finer polish with less friction and liability to wear the glands.

Where the rods are carried through the backs as described, their diameter ought to be calculated from the formula for deflection. If thus calculated it is obvious that the rod should be the same diameter back and front, as the deflection will be governed by that of the smallest diameter.

The formulæ for the deflection of beams of uniform cross section are as follow :—

Let W = load in lb. ; l = length of rod in in. ; I = moment of inertia = $0{\cdot}7854\ r^4$ for round bar, r = radius of rod in in. ; E = modulus of elasticity = 30,000,000 for steel ; δ = deflection in in. Beam supported at ends, load in middle :

$$\delta = \frac{1}{48} \times \frac{W \times l^3}{I\ E}$$

Beam supported at ends, load uniformly distributed : $\delta = \frac{5}{384} \times \frac{W \times l^3}{I\ E}$

By using these two formulæ, which only apply within limits of elasticity, given the weight of piston and rod and the span, the diameter may be calculated approximately. Find next the diameter of the rod by the following empirical formulæ :— $d = 0{\cdot}128D + \frac{5}{8}$ for high-pressure cylinder, and $d = 0{\cdot}1D + \frac{3}{4}$ for low-pressure cylinder. The latter gives a proportionately smaller diameter for the corresponding weight of the low-pressure cylinder, and must be checked by the formulæ for deflection.

Should the deflection come out too great, it must either be made larger or the rod be cambered sufficiently that when the piston is in place it will just bring the rod straight. This is no doubt the more correct method, as even with a disproportionately large rod the deflection may be excessive for good working. Some makers camber the rod after it is turned. The rod is supported in bearings set a distance apart corresponding with the exact centres of the slippers which the engine will have when at work, and loaded with an amount equal to the weight of the piston and the deflection noted. The rod is then given a set equal to this deflection. When the piston is fixed on the rod and placed in position, the rod will be brought to the straight. Collman's method is the opposite of this. The rod in its black state is cambered an amount calculated approximately by the formulæ already given for deflection. The rod is made long enough so that the ends can rest on the two plummer blocks of a lathe, centred to the exact span at which it is intended to work, with the convex side of the rod upwards, and with the ends of the rods at the same vertical height to each other from the bed of the lathe. The ends of the rod are now screwed down fast to the blocks. In this position the rod is now loaded with the exact weight of the piston at the point corresponding with its proper position, and brought to an approximate straight line. The turning of this rod fixed in the blocks is accomplished by a special tool working round the bar and sliding along it. For this purpose the lathe saddle carries a ring-shaped rotating disc, in which is fixed the cutting tool, which is so arranged that the cone and threads for fixing the piston can also be turned and cut. When the finished rod is disengaged from the lathe it again takes the cambered form, but when placed in position with the piston it assumes a straight line again. Care has to be taken that the cambered side of the rod is placed upwards when placed in the cylinder.

A simpler but incorrect method of effecting the turning of the cambered rod is to fix the black rod between the two centres of an ordinary lathe. A ring fixed in a strong socket and fitted with several set screws, exactly central with the lathe centres and capable of turning round, is placed in the middle, or where the piston has to be fixed. The rod is then turned with the convex side upwards and loaded with the required weight, which straightens the rod, which is then kept in position by the set screws and turning ring. By this method, however, when the tool reaches the centre the ring has to be removed to the other side of the tool and reset to the proper position, with the likelihood of a less accurate result. Rods made in this way should be calculated by the empirical formulæ given, to avoid any future bending which may take place through future wear and tear or by reason of the rod being at some time "skimmed" up.

(*To be continued.*)

The Modern Marine Boiler.*

THE marine engines, often things of beauty and always interesting in their steady, graceful, and potent functions, receive all the praise when the ship is making or breaking a record. While it is not at all uncommon to find the ordinary commercial traveller versed in the technicalities of this portion of the machinery, and able to discourse glibly on the relative "horse-power" of the leading transatlantic liners, it is seldom that he has much knowledge of the boilers—those vast factories and reservoirs of that power of which he speaks, and which, in their hot and grimy compartments forward, giving but few signs of the intense strain they are under during every moment of the run, perform a duty not in the remotest degree indicated by a share of the glory of a successful trip. It is probable, nevertheless, that in the mechanical world to-day more thought is being bestowed on the boilers than upon the engines proper; and far from being commonplace accessories, they are constructions of the most scientific character, combining in their proportions the results of the greatest range of experiment and deepest study. Each element is so carefully considered, both by itself and in its relation to the other parts, that the final outcome is an apparatus of elegance to the professional eye, and one in which strength, durability, accessibility, and efficient capacity are adjusted to a nicety which satisfies the conditions imposed with regard to the production of a given power within a limited space and with a minimum weight of metal.

*By A. B. Willits, U.S.N., in the "Engineering Magazine" (N.Y.).

The boilers of the United States man-of-war "New York," now in course of completion in Philadelphia, are of greater dimensions than any previously built in this country. They do not differ in size, in any marked degree, from the largest built abroad for the ocean greyhounds, although the latter usually possess more heating surface in proportion to grate, to their economical advantage at full power. Each is 15ft. 9in. in diameter, and 18ft. long, and is double-ended, having an exactly similar arrangement of furnaces and tubes in each end. The tubes conduct the hot gases of smoke of combustion from the backs of the furnaces to the fronts of the boiler, whence they are led to the smoke-pipe by light castings, attached after being placed on board ship, this type being styled the return fire tubular, or more generally the Scotch boiler. The material is open-hearth steel, subject to the closest inspection and severest tests before acceptance. The nine great sheets composing the cylinder are more than 1¼in. thick (1 21-64th), and weigh between 5000 and 6000lb. each. The flat heads are thinner, but so closely stayed by heavy steel braces running from end to end, as to compensate for that. Indeed, if wholly unstayed, they would have to be of simply monstrous proportions to sustain the pressure put upon them, something like 10in. in this case, which would be both impractical and absurd. Spherical ends would, of course, obviate bracing and ultra thickness, but the practical advantages of flat ends are retained by a scientific system of bracing. Each boiler weighs about 70 tons, and contains 8 furnaces, and 1148 tubes, aggregating nearly a mile and a half in length. These form the major part of the 5200sq. ft. of heating surface, as they are always surrounded by water to be evaporated. The quantity of water necessary to fill the boiler to a proper steaming height is about 30 tons, yet under forced combustion such as is always used for full power, this is converted into steam at the rate of one-third of a ton per minute, demanding a continuous supply from the pumps, at that rate, to maintain a safe level. The furnaces contain 165sq. ft. of grate, upon which is burned nearly three tons of coal per hour (about 40lb. per square foot per hour), with an air pressure of less than ⅛th of a pound per square inch above the atmosphere. The steam pressure carried is 160lb per square inch above the atmosphere, quite the usual pressure for triple-expansion engines; but when it is realised that this gives a total disruptive strain on the cylinder shell of more than 6,500,000lb., it no longer appears as ordinary but rather terrific—a force, too, which is not evidenced by the placid exterior of this veritable torpedo.

Taking the entire six main boilers of this ship, a brief summary of data is at least impressive and suggestive of the importance of these elements. Their net weight is more than 400 tons, and they contain about three-quarters of an acre of heating surface, with 8½ miles of tubes. Their 48 furnaces will consume more than 400 tons of coal a day, and evaporate 140 tons of water an hour to produce the 16,500H.P. needed to drive the vessel 20 knots an hour. They will occupy a floor space in the depths of the ship, 100ft. long by 36ft. wide (double that allotted to the main engines), and will require a force of 100 men to properly attend to and manipulate them. A contemplation of these few facts makes it obvious to anyone that a high degree of skill and efficiency on the part of the attendants is important and necessary, and that the element of carlessness here would be as likely to cause havoc and disaster as it would in the engine room or on the bridge. Eternal vigilance is the watch-word; responsibility and anxiety being ever present with the performance of this unseen duty. It has been mentioned before that the boilers of the great ocean liners are proportioned with a larger ratio of heating surface to grate area than those of men-of-war, and it is to this fact that the former show a more economical performance by obtaining a given power on a lower coal consumption. Badly-informed writers have used this to animadvert upon the designers or constructors of warship machinery, without troubling themselves to find a reason for the difference in results, yet it requires only ordinary reflection to perceive that the conditions in the two cases are wholly dissimilar.

The engines of mail steamers are driven to their full power at all times, and the question of coal expenditure becomes of financial importance; hence their boilers are always designed especially for economy, and the necessary space in the ship is unhesitatingly taken. To follow this line in a naval vessel, of much less length, for equal power, would incur a very excessive sacrifice of hullroom over that now given.

The adoption of forced draught has made it possible to obtain enormously greater evaporation from a boiler of ordinary design than was possible with natural draught, by reason of burning a much greater quantity of coal on the same grate. To do this economically, however, the heating surface, or surface of absorption of the heat from the gases of combustion, must be greatly increased, which means larger or more numerous boilers. The designers of machinery for warships have carefully considered the bearing and contingencies of this feature, and have adopted as efficiently proportioned boilers as the exisiting conditions justify. The assumption is that the full power of this class of vessel never will be required, except for short periods, when the production of it at the lowest rate of economy will not be vital; and a mean is considered advisable, where space is of such paramount importance. The quality of workmanship shown in the details of construction, with its guarantee of durability, is second to none in the world.

The desire of marine engineers is to produce a type of boiler which shall do away with the necessity of such enormously large and heavy shells, and present a lighter substitute which will perform the duties of both envelope and heating surface conjointly. A very great reduction in size and weight is thus possible, and the numerous forms of tubulous boilers are the outcome of this desire, which, year by year, is intensified by the gradual necessary increase in the proportions of the cylindrical type. The tubulous boiler consists of numerous tubes of comparatively small diameter, and variously connected, inside of which the water circulates, and around which a light casing of metal, lined with refractory material, is built to confine the hot gases to action upon their outer surfaces. Thus the tubes become parts of the shell as well as continuing to be heating surface, and by reason of small diameters, even in the connecting drums, all very thick plates are avoided and the highest desirable steam pressure safely carried. The amount of contained water is also greatly reduced, as well as much more effectively disposed for evaporation than obtains in the Scotch boiler, where the water is solid bulk, much of it below all heating surface, and only brought to the boiling point slowly or by forced circulation. For years this tubulous form has found favour for use in smaller vessels, such as torpedo boats or launches, but its adoption for larger ships has been delayed for reasons which temporarily, at least, counterbalance the evident advantages of less weight and size, better circulation, more efficient evaporation, and the rapidity with which steam can be raised. One of these is that their very compactness militates against their accessibility for cleaning and examination, and it is feared that without a possibility of unusual care their decay will be rapid and their life short, when placed in the damper holds of deeper vessels, where their use will be interrupted by long periods of idleness. Besides this, the ready renewal of defective tubes is not perfectly provided for in most designs, and many practical difficulties have attended this work with the smaller sizes, despite a theoretical demonstration of the ease of such operations. Especially is this true after some considerable use, and indicates a probable trouble and incites caution in those who would like to abandon the bulkier but more accessible form.

Experiment, of course, is the only way to prove their real adaptability to the service required, and the Government has placed on board the United States cruiser "Monterey," just built in California, four tubulous boilers. Much interest centres in the coming trial of these boilers, but upon the reports which shall be made by the engineers in charge, after a continuous experience with them under the various conditions of a cruise, will depend any verdict of value. The field is open still for inventive minds, as the perfect type has not yet been evolved. The study is in better shape now by reason of the many devices already constructed and found wanting, as their faults as well as their points of excellence serve to aid the designer in making his lines for improvement.

THE copper statistics for August are rather more favourable, stocks at length showing a small reduction. The total stocks at the end of August were 59,718 tons, compared with 59,738 tons at the end of July; but the mid-monthly figures showed that on August 15 the stocks had increased to 61,831 tons. The deliveries during the month were 8755 tons, against 8499 tons during July; while the supplies were 8735 tons, compared with 11,633 tons,

Metal Trade Memoranda.

The export amount of gold from Cape Colony during the month of August amounted to £405,000.

It is stated that tin has been discovered in large quantities in the neighbourhood of Mergui, Burmah.

The output of ore from the Marbella Iron Ore Company's mines for the month of August was 5251 tons.

The Glasgow Iron Company, Wishaw, have commenced operations with an additional furnace for the production of basic iron.

After a cessation of more than twelve months, the steel rail mills at the Moss Bay Iron and Steel Works, Workington, were re-started on the 29th ult.

It is said that several rich and well-located iron and manganese mines in the district of Manzanillo, Cuba, have recently been sold to an American syndicate, which will immediately build a railway to place them in direct communication with the port.

No arrangement having been come to between the representatives of the steelworks' proprietors of South Wales and the workmen, the employers have given notice to the men at all the steelworks to terminate all contracts in one month, after which they will run from day to day.

The production of pig iron in Lincolnshire during the first six months of the current year amounted to 109,847 tons, against 121,910 tons for the corresponding period of 1891. The Redbourne Hill Company have blown out one of their furnaces at the Lindsey Works, and have started one at the Redbourne Works.

A very rich lode of tin has been discovered at Brookstead, Tasmania. The lode is thickly impregnated with tourmaline, and is unique, inasmuch as this formation, quite novel in Tasmania, has been proved to carry tin of the very best quality, giving a result when smelted of 75·4 per cent. of pure tin. The lode can be clearly traced for fully two miles, and practical miners state that the lay of the country is such as to render the opening up of this big property an easy task. The Brookstead estate is situated about 10 miles from Avoca, up the St. Paul's Valley, and is owned by Messrs. Fitzgerald.

The Metal Market.

PRICES CURRENT.

LONDON, September 5.

COPPER opened quietly at 1s. 3d. decline, and further lost 2s. 6d. on realisations induced by the poor demand; but with less offering in the afternoon values recovered somewhat, and closed steady, but 2s. 6d. lower on the day. Cash sold at £44 7s. 6d. to £44 5s., but rallied to £44 6s. 3d., while three months was done early at £44 16s. 3d. to £44. 15s. Sales, 250 tons. Settlement price, £44 5s. For Montana Matte 9s. per unit has again been paid. English tough, £47 5s.; best selected, £48 10s.; strong sheets, £56.

TIN has been quiet, trading being chiefly in switching over of expiring contracts, for which a premium of 5s. had to be paid. Prices were steady for near positions, with good buyers at £92 17s. 6d., or 2s. 6d. below sellers' price. About 50 tons were carried over three months at a difference of 5s., and for a small quantity of three months £93 5s. was paid outright. Closing values are steady, with cash unchanged and three months 5s. better. Settlement price, £93. English ingots, £96.

PIG IRON has ruled firm in response to Glasgow advices, and 500 tons Scotch cash made 42s. 0½d., an advance of 1d. One month open in sellers' option was offered at 42s. 1d., and three months at 42s. 8d., with buyers at 42s. and 42s. 6½d. respectively. The close is steady with Scotch 1½d. better, but otherwise prices are unchanged. Settlement prices:—Scotch, 42s. 1d.; Middlesbrough, 40s. 6d.; hematite, 50s.

TINPLATES steady. I.C. cokes, f.o.b. London, 13s.; Liverpool, 12s. 6d.; Swansea, 12s. 3d.

LEAD ruled quiet at Friday's rates for Spanish, at £10 2s. 6d., sellers; but English was 2s. 6d. lower at £10 5s. to £10 7s. 6d.

SPELTER was flat and nominally unchanged for September at £20 12s. 6d., but on the receipt of Continental advices near the close, October shipment was offered at £20 10s. Silesian special brands have been done again at £21 ex ship, in anticipation of reduced prices when the convention meets at the end of the month.

ZINC SHEETS.—Silesian are 5s. lower and easy, with ordinary at £23 ex ship, but there is little inquiry. Belgian are also easy, V.M. brands being 10s. down, with offerings ex ship at £23 10s., and f.o.b. Antwerp at £23 5s.

OFFICIAL CLOSING QUOTATIONS.

	£	s.	d.	£	s.	d.
COPPER—						
G. M. B.—Cash	44	6	3	—44	13	9
" Three months	44	16	3	—45	3	9
English tough		—		—	—	
Best selected		—		—	—	
Strong sheets		—		—	—	
TIN—						
Fine foreign—Cash	93	0	0	—93	10	0
" " Three months	93	5	0	—93	15	0
Australian—Cash	93	10	0	—94	0	0
PIG IRON—				s.	d.	
Scotch warrants - Cash				42	1	
" One month				42	3	
Middlesbrough—Cash				40	6	
" One month				—		
Hematite—Cash				50	0	
" One month				—		

GLASGOW, Sept. 5.—Business on the pig-iron market continues confined to Scotch. Some 11,000 tons changed hands, several lots passing repeatedly between parties, so that net sales were below the amount specified. About 6000 tons were dealt with for cash, the balance being on forward account. Cash operations were active, as there has been some overselling, and warrants for prompt delivery are scarce. One thousand tons sold at 42s. 7d. three months fixed and unofficially; 1000 tons Cleveland sold

at 39s. 3d. all the year with sellers' option. Shipments for the week reached 6319 tons, being an increase on the corresponding week of last year of 514 tons, thus bringing the increase for the year to 29,592 tons.

QUOTATIONS.

	Highest. s.	d.	Lowest. s.	d.
Scotch warrants—Cash	42	2	42	1
„ One month	42	3	42	3
Middlesbrough—Cash	40	6	41	6
„ One month	40	6	—	
Hematite—Cash	50	0	50	0
„ One month	—		—	

Official Gazette.

Partnerships Dissolved.

H. PULLEY AND A. H. DAWSON, under the style of H. Pulley and Co., Wednesbury, engineers, ironfounders, and general and ship smiths.

SIMPSON AND HILL, Aldersgate-buildings, E.C., manufacturers of electrical, optical, and mechanical apparatus.

THE BANKRUPTCY ACTS, 1883 AND 1890.

Receiving Orders.

CHARLES WALTER COX AND FREDERICK ROBINSON (carrying on business as Cox, Robinson and Co.), Liverpool, electrical engineers.

WILLIAM JOHN PORTER, Birmingham, tinplate worker.

WILLIAM HENRY PHILLIPS, Glastonbury, late Exeter, gas engineer.

Adjudications.

J. BAXERES-ALZUGARAY (trading as Baxeres and Co.), Broad-street-avenue and Bishopsgate-street Within, City, and Arlington-street, W., and Prebend-street, Islington, civil engineer and metallurgist.

JAMES HOVE COLLINS, electrical engineer.

SAMUEL SMITH WELCH, Plymouth, engineer, late in copartnership with A. E. Bradshaw, as Welch, Bradshaw and Co.

JOSEPH MILLS, Sheffield, cutlery manufacturer.

Trade Marks.

The following is the Official List of Applications published from August 24 to August 31, for the Registration of Trade Marks, so far as relates to the Metal Trades.

CLASS 5.

CRUGjutstål

166,201. Cast steel. LARSBO-NORNS AKTIEBOLAG, Wikmanshyttan, Sweden; iron manufacturers.—26th July, 1892. MARK used since 1860. *Address for Service in the United Kingdom*, c/o The Trade Mark Owners' Mutual Protection Association Limited, 17 and 18, Basinghall-street, London.

CLASS 6.

DAILY BREAD.

161,720. Machinery of all kinds and parts of machinery, except agricultural and horticultural machines included in Class 7, namely:—Bottle washing machines, capstans for use on land, cards (machine), carpet sweepers, cinder sifters (machines), combs, machines, corking machines, crabs, cramps, cranes, cutting-out presses, derricks, differential pulleys, drilling machines (other than agricultural), equilibrium drills, eyeletting presses, fire engines, forges (portable), jacquards (being parts of machinery), knotter plates, lubricators (self-acting), mortar mills, morticing machines, printers' rollers (parts of machines), pumping engines, pumps, railway joints, riveting machines, rock drills, slide rests, steering engines, stone breaking machines, turnstiles, vacuum brakes, winches, wood working machinery, wringing machines. PAUL PFLEIDERER, 86, Upper Ground-street, Blackfriars, London, S.E.; engineer.—6th January, 1892.

CLASS 6.

KERASHA.

167,571. Wood pulleys, being parts of machinery (other than agricultural or horticultural machinery), and all other goods included in Class 6. KERR AND JUBB, 29, Squareroad, Halifax; belting manufacturers and general mill furnishers; and HENRY ALEXANDER COLE, 4, Drury-lane, Liverpool; agent.—23rd June, 1892.

New Companies.

THE BILSTON WIRE COMPANY LIMITED.—This company was registered on the 26th ult., with a capital of £50,000, divided into 500 shares of £100 each, to carry on the trades or businesses of drawers and manufacturers of wire, wire rods, wire ropes, nails, steel converters, steel and iron manufacturers, etc.

THE CARBOID OIL-LESS BEARING COMPANY LIMITED.—This company was registered on the 25th ult., with a capital of £2000, divided into 2000 shares of £1 each, to purchase or otherwise acquire any inventions and patents, concessions, etc., relating to the manufacture and application of carboid. Registered by Messrs. Deacon, Gibson and Metcalfe, Leadenhall Chambers, 4, St. Mary Axe, London, E.C.

MECHANICAL TIME STAMP COMPANY LIMITED.—This company was registered on the 24th ult., with a capital of £5000, divided into 2500 preference shares of £1 each, and 2400 ordinary shares of £1 each, to carry on in the United Kingdom and elsewhere the trade or business of manufacturers and dealers in (either wholesale or retail) that class of instrument known as hand stamps, and for machines for giving information as to the time of day, date, etc., and for recording the same. Registered by Messrs. R. W. Cooper and Sons, 7, Victoria-street, Westminster, S.W.

PAUL'S PATENT RAPID-COALING BARGE SYNDICATE LIMITED.—This syndicate was registered on the 26th ult., with a capital of £10,000, divided into 200 shares of £50 each, to acquire by purchase the British and foreign patents and patent rights of Mr. Michel John Paul, of, and in an invention relating to means for coaling ships, or for conveying coal or other cargo in bulk to wharves, etc., to be discharged.

ROBERT DEMPSTER AND SONS LIMITED.—Registered on the 25th ult., by Thomas England, Halifax, with a capital of £30,000, divided into 3000 shares of £10 each. Object: To acquire the business of gas, chemical, and hydraulic engineers, carried on by Robert Dempster and Sons Limited (a company incorporated on August 2, 1887), at the Rose Mount Works, Elland, Yorkshire, and generally to carry on such business in its various branches.

THE MIDLAND FUEL COMPANY LIMITED.—This company was registered on the 30th ult., with a capital of £20,000, in £10 shares, for the adoption and carrying into effect an agreement dated August 22, 1892, and made between Mr. Samuel Butler of the one part, and the Trustees for the company of the other part, to acquire the letters patent, dated April 12, 1884, granted to the said Mr. Samuel Butler for improvements in machinery or apparatus for heating and mixing the materials employed in the manufacture of artificial fuel, and to carry on at Birmingham or elsewhere, the trade or business of makers, manufacturers, buyers, sellers, and shippers of patent and other fuel.

Letters to the Editor.

*** *We do not hold ourselves responsible for opinions expressed by correspondents.*

*** *The name and address of the writer (not necessarily for publication) must in all cases accompany letters intended for insertion, or containing queries.*

*** *Letters intended for publication in the current week's issue must reach our Manchester Office not later than by the first post on the Tuesday preceding the date of publication.*

AWARDS FOR INVENTIONS SCHEME.

To the Editor of THE MECHANICAL WORLD.

SIR,—Your leader referring to the above is a keynote of success, and to your question, "Do we at the present time utilise to the fullest extent all the energy and inventive abilities we are capable of reasonably applying?" I answer most decidedly, No. Why is this? For the want of some society based on sound business principles, which shall take up, examine and report upon all matters connected with the inventive abilities of capable men.

It is easy to express a want, but the difficulty is to provide a remedy. Have we sufficient material to work upon? Is it of a character worth taking into account? Can the scheme be worked as a satisfactory business? Can the *bonâ fides* of such a society be ensured? Can the claims of inventors be satisfied? Is there room for proper invention and improvement? Is it possible to utilise all such inventions?

To all of the foregoing we may answer, Yes. There are many managers, foremen, and workmen who are well able to furnish intelligent schemes, whereby time, money, and life would be saved, and a general all-round benefit would accrue by the utilisation of the products of their brains.

The present difficulties in the way of men gaining advantage by their inventive genius are greatly due to the want of a market for their products. For example, in the case of an official, we will assume that in some difficult case he provides a remedy. He is fully aware that it would be a remedy and improvement in many other conditions, but, owing to circumstances, its power for good is lost, except in the one case. But, given a society to which he may send his idea, intelligently laid down and worked out, he would be benefited thereby if the idea was accepted, and others would receive the advantage of the scheme, which under present conditions would be lost. Many such cases arise day by day, simply for want of opportunity and the absence of a market.

In the case of a workman, he may, in the progress of his work, hit upon an improvement which would be of immense advantage to many others. He cannot afford to patent it; he is afraid to give his foreman or manager the idea, for fear he should claim it. But give him a society to send it to, and it may turn out to his advantage, and be useful to others.

The far-reaching influence of THE MECHANICAL WORLD can do much to bring together a number of tried men, with whom the general run of inventors would be satisfied and be willing to trust with embryo ideas, upon which the opinion expressed would be accepted as final, whether favourable or otherwise.

Of one thing there is no doubt—great good could be done by an Inventions Award Society, which would largely influence the prestige of England as the foremost manufacturing country in the world.

All that is required is opportunity, and given that, genius will no longer be latent, but will be turned to the advantage of all, and inventive effort will receive its due recognition and reward. J. BATEY.

Dublin, Aug. 29.

Miscellaneous Items.

A telephone exchange is being erected in the town of Bucharest, Roumania.

The Mersey Docks and Harbour Board have decided to establish a system of electric lighting at Wapping Dock warehouse.

Mr. John Furness Atkinson, of the Milton Works, Sheffield, was on the 1st inst. installed as Master Cutler of Sheffield.

The Swansea Harbour Trust have given instructions for plans to be prepared for the extension of the Prince Dock, at a cost of £100,000.

A German firm at Dresden, Saxony, is manufacturing plate glass in which wire netting is embedded. This construction not only gives additional strength to the glass, but it also protects the windows from burglarious attacks.

Camphor enters largely into the manufacture of smokeless gunpowder, and in consequence of the large increase in the manufacture of such powder, the price of camphor has risen, in the case of the Chinese variety to 130s. per cwt., and in the case of the Japanese variety to 137s. 6d. per cwt.

The death took place on the 31st ult. of Mr. Edwin Francis Jones, late managing partner in the firm of Jones, Dunning and Co., Normanby Ironworks, Middlesbrough, and one of the oldest ironmasters in Cleveland, he having been connected with that trade for nearly forty years.

The United States Circuit Court has, on the motion of the Remington Typewriter Company, granted an injunction against the agents of the Franklin, restraining the sale of that machine on account of infringement of Remington patents. The decision is an important one, as it proves the control of the fundamental patents, and may affect other makers of typewriters.

The advisability of promoting a scheme to construct a new railway in Lincolnshire, from Boston to Bourn, is under consideration. The idea is to put the Midland counties in direct communication with Boston Docks, and this can be accomplished by making the above line to join the new Midland railway from Saxby, in Leicestershire, to Bourn, which is now fast approaching completion. The route would probably be through Swineshead and Donington, and along the east bank of the Forty Foot, crossing the river somewhere in Dunsby or Morton Fens.

It was mentioned by the chairman at the meeting of the Rhondda and Swansea Bay Railway Company, held on the 27th ult., that a scheme was on foot for building one of the largest docks in the Bristol Channel at Port Talbot, where the natural facilities greatly favour such an undertaking. A powerful syndicate has already been formed, and has brought negotiations with Miss Talbot, the owner of the site in question, to a successful termination. A Bill, it is stated, will be promoted in Parliament in the forthcoming session to obtain Parliamentary powers.

On the 1st inst. the completion of the Metropolitan Railway extension to Aylesbury was formally celebrated. The extension is, as is generally known, part of the scheme for bringing a new trunk railway into London from the North. Allusion was made in the course of yesterday's proceedings to the Parliamentary difficulties experienced, and to the practical standstill of the work because the last session had not been prolonged by one day. It was added that a gap of 93 miles remains to be filled before the connection with the Manchester, Sheffield and Lincolnshire system will be effected.

On the 29th ult. a new light was added to facilitate the navigation of the Firth of Forth, when the blind beacon tower on the Bismar Rock in St. Margaret's Hope was lit for the first time. In the afternoon the steamer "Pharos," belonging to the Commissioners of Northern Lighthouses, approached the rock and landed a party who filled the tank with gas, in the expectation that it would feed the light for three months. The light is a fixed one, and the inauguration was a complete success. This is a trial departure, and should the experiment succeed it is understood that the new method will be adopted on other solitary rocks around the coast.

The death is announced of Mr. J. W. Grover, M.Inst.C.E., F.S.A., etc., of Westminster and Clapham Common, at the comparatively early age of 56, after a long and painful illness. He was a pupil of the late Sir Charles Fox, and was first employed on the surveys of the Great Northern of Portugal Railway, under Sir John (then Mr.) Fowler. Subsequently he was engaged on the surveys of various railways in England and on the Continent, and prepared the designs for works of the Mexican Railway. During the last 20 years Mr. Grover had been largely engaged in the construction of waterworks, especially in chalk and limestone districts.

The publisher of "The Mechanical World" will send a prepaid parcel of specimen copies to anyone, in any part of the world, who can distribute them advantageously amongst his engineering friends. Business card or bill-head should be enclosed as a guarantee of good faith, and number of copies stated.—Address: 391, Strand, London, or New Bridge-street, Strangeways, Manchester.

Queries.

☞ Readers are invited to avail themselves of this section for practical information on questions relating to Mechanical Engineering and the Scientific Industries.

☞ Queries and Replies should arrive at the Manchester Office not later than by the first post on the Tuesday preceding the date of publication.

PLUMBERS' UNION.—Required the address of the secretary of the Operative Plumbers' Union.—PLUMBER.

TINPLATE MILL ROLLS.—Can any reader give the proper mixture for brasses for the bearings of these rolls?—TINPLATE.

WHEEL MOULDING MACHINE.—Required the makers of a good wheel moulding machine for toothed wheels, up to 6ft. diameter.—SMALL FOUNDER.

EXPANDING RIMERS.—Will "W. A. S. C." kindly give further information *re* expanding rimers as promised, if possible?—J. W. C.

MAKERS OF STAMPED FORGINGS.—Required the names and addresses of firms making drop stamped joints and pins in small quantities.—J. T.

MAKERS OF SMALL CASTINGS.—Required the names and addresses of makers of light pattern worm wheels and small furnishing wheels.—H. M.

JAMES' PATENT SOUNDING MACHINE OR SUBMARINE SENTRY.—Can any reader oblige with particulars of this apparatus, or name of makers?—J. P.

MAKERS OF COMPRESSED PAPER.—Will any reader inform me of the address of a maker of compressed paper, such as is used for carriage wheels and the like?—T. D.

BOILER INSPECTORS.—Will any reader inform me as to the nature of examinations held for boiler inspectors, and if there are any books treating on same?—BOILERMAKER.

WOVEN BELTING.—Can anyone give me the recipe for or supply me with the proper paint for cotton belting? I can weave it right enough, but cannot get a satisfactory paint.—BARCELONA.

HARDENING CIRCULAR SAWS.—Can anyone tell me how to harden a circular saw 20in. diameter and ⅛in. thick, to saw cast iron? I want to harden the cutting part only, and not the body of the saw.—J. WILSON.

HOT-AIR ENGINE.—Will some reader of THE MECHANICAL WORLD kindly oblige me with a section and principal dimensions of a ½H.P. single-acting hot-air engine of the Stirling cycle?—GEO. H. PERKINS, North Queensland.

VOSPER'S ENGINE.—I have a Vosper's patent high-speed four-cylinder engine, and should be glad to know what the cut-off in each cylinder should be; also the position of eccentric sheave at any given point? I believe the eccentric sheave has been altered before the engine came into my hands. A sketch would oblige.—R. F.

LOSSES IN STEEL FURNACES.—Could any reader kindly inform me the average per cent. of actual loss, and the average per cent. of skull, in the charge of a Siemens open-hearth steel furnace working charges of from 30 to 40 tons? And also the per cent. of loss in heating slabs and ingots in the Siemens regenerative gas furnace?—J. R. R.

BOAT PROPULSION.—If a boat floats down a river, will it be carried forward at the same speed as the stream is flowing? Or can it be proved that it will go slower than the stream? How much force in lb. will be required to propel a boat of a given weight against a stream or up a river flowing with a certain velocity, so that the boat shall move up the river with the same speed that the stream is flowing down?—HYDRA.

CAMS AND BOWLS.—(1.) When subject to little pressure, studs work in the cam race without any roller or bowl on them. At what amount of pressure ought a roller to be used on the stud to work in the race? and how is the pressure on the stud to be calculated for a cam to turn rotary motion into to-and-fro straight motion if the groove or race is 12in. diameter and moves a bar 4½in. in each direction? (2.) What is the pressure on a wiper cam to lift 2cwt. at 1¾in from shaft? and also, what is the strain on the cam shaft, and how can I find it for other wipers? (3.) What is the pressure on the ball bearing in a ball mill, and how is it found? The mill is to grind 75lb. at a time, and the ball works in a hemispherical footstep bearing and at end of inclined spindle, the top end of which makes a circle of 1ft. diameter in turning. Weight on spindle about 1 ton.—OATS.

LOCOMOTIVE CONSTRUCTION.—Will any correspondent enlighten me as to the mode adopted in locomotive work in order to fix the position of the axles (horizontally) so that each axle may have a predetermined portion of the total weight resting upon it? Say:—

Load on leading axle	.....	0·32
„ driving „	.....	0·48
„ trailing „	.....	0·20
		1·00

Of course, I am aware there are certain circumstances—such as length of barrel, position of firebox, etc.—which in practice to a great extent influence this; but the point I wish clearing up is: Given the total weight, how are the positions of axles determined so that the pre-arranged weights rest on them? An answer would be of service to others as well as to.—HILLSLAND.

Replies.

☞ Owing to the constant increase in our correspondence, we regret that we have no alternative but to announce that we cannot reply by post to Queries even when stamped envelopes are sent.

☞ Queries and Replies must in all cases be accompanied by the names and addresses of the writers, as no notice will be taken of anonymous communications.

R. JARMAN.—Apply to Messrs. Martineau and Smith, Birmingham.

W. MORRISON.—You will find full particulars in our issue for August 23, 1890.

ARCHIMEDES.—Try Messrs. Thomas Firth and Sons, Wolverhampton-street, Walsall.

W. R. T.—Messrs. J. Hopkinson and Co., Huddersfield, are makers of corrugated [illegible] joints.

MARINE.—Apply to the Assistant Secretary, Marine Department, Board of Trade, Whitehall, London.

G. J.—(1.) We can give you no better definition than is suggested by the title. (2.) There is no book on the subject.

BRAZIL.—Messrs. Legrande and Sutcliffe, 100, Bunhill-row, London, E.C., are makers of well boring machinery.

SMALL FOUNDER.—If you give us further particulars of the kind of furnace you require we will endeavour to assist you.

LOCO. APPRENTICE.—You can obtain all particulars by applying to Mr. John Lockie, 2, Custom House Chambers, Leith.

R. J. HICKSON.—You will require 114 holes, the combined area of which will be very slightly in excess of the area of a 4in. circle.

W. CHAPLIN.—Yes; the cutting tool illustrated in our last issue is patented, but we cannot give you the number of the specification.

VULCAN.—Messrs. Joseph Wright and Co., Tipton, are the makers of the Berryman feed-water heater, which will doubtless suit you.

SASTRE.—There is no rough-and-ready way of calculating the power of triple-expansion engines. You will find full details in "The Mechanical World Pocket Diary."

R. LACEY.—We would advise you to procure a copy of Seaton's "Marine Engineering," 18s., from which you will obtain all the information you require. It may be had from this office.

PROPELLER.—Barnaby gives the probable average efficiency of a good screw propeller as 0·65. As a propelling device, the paddle-wheel is not inferior to the screw, but generally it is less suitable.

C. HUTCHINSON.—You can obtain all particulars from the prospectus of Whitworth Scholarships, to be had from the Secretary, Science and Art Department, South Kensington, London, S.W., price 3d.

ENGINE.—Set the engine on the top dead centre, and change the position of the eccentric on the crank shaft so that looking along the shaft, its centre is as much to the left of the centre line as it previously was to the right, or *vice versâ*.

J. BROOKS.—A "fulcrum" is the point about which a lever turns. "Compound levers" are combinations of ordinary levers, usually employed for developing great power in a small space. A testing machine and a weigh-bridge are examples.

J. ROBURTSHAW.—Prussiate of potash renders iron nearly as hard as steel by heating the iron to redness, sprinkling the potash finely powdered upon it, and then plunging the iron into pure cold water; but the hardness is confined to the surface, and only for articles not exposed to much wear can a sufficient coating of steel be obtained by this process. Greater and more uniform effect is produced by a perfectly tight box, and animal charcoal just sufficiently burnt to admit of being reduced to powder, in order that more of it may be got into the box with the articles; bones reduced to dust answer the purpose equally well. The box should be of plate iron not less than ¼ to ⅜in. thick. The size and shape differ according to the articles operated upon. The box is furnished with an iron lid with two holes pierced in for drawing testing pieces out, if required. The box may be strengthened against buckling by riveting a piece of iron about ⅜in. square inside the box about 1in. from the top. This will also answer for the lid to rest upon, and prevent it from pressing upon the articles when expanded by the heat. Clay or loam put between this iron square and the lid makes a secure joint. Two holes are pierced in the box at opposite sides just above the lid, for inserting two iron pins and making the joint more secure. Upon a small scale a good box may be made by welding a plug into one end of a piece of wrought iron pipe, and using a loose plug for the opposite end, the loose plug being fastened into place with an iron pin passing through it and the pipe, and luted with clay. For a small article a box may be formed of loam, which is gradually dried before it is exposed to a red heat. The articles being finished, except polishing, are put into the iron box in alternate layers with the animal charcoal, commencing on the bottom of the box with charcoal to the thickness of about ¾in. Upon this a layer of the articles is placed, then another of charcoal about one-third of the first, and so on till the box is nearly full, finishing with charcoal about the thickness of the first layer, leaving room every way for the expansion of the articles by the heat, otherwise they will bend each other in the box. The packing completed, the lid is put on and the box luted. The whole is now placed in a suitable furnace. The fire must not be urged, as the contents of the box require to be very gradually and uniformly heated to redness and retained at this heat for the period required for the depth of steel desired.

DYNAMO CONSTRUCTION.—I am constructing a small dynamo of the "Gramme" type, A pattern. It is to be shunt wound, and to give 120 C.P. at 45 volts. I had decided to wind the field magnets with about 12lb. No. 18 double cotton-covered wire and the armature with about 3¾lb. No. 18. Now, I have been informed that I have got the resistance on the field magnet coils too low, and would like to know if this is the case or not?—T. WALLEY.—*A.*—For a dynamo of the size named there would not be sufficient resistance in the magnet coils. The wire on the armature should be 2½lb. of No. 18 double silk covered, and on the magnets 26lb. of No. 20 double cotton covered copper wire. Armature of Gramme ring type. This will give about 45 to 50 volts and 8 to 10 ampères. I presume you understand winding of armature; if not, write again.—T. MANWARING.

TRACTIVE FORCE.—(1.) If 120lb. per ton be a sufficient tractive force to draw a load on a level road, what tractive force per ton will be required to draw the load on a road inclined 1 in 30? (2.) A traction engine weighs 6 tons, and is capable of drawing 20 tons over a level road; what will it draw up a road which is inclined 1 in 100? Coefficient of traction = 0·02. —F. B.—*A.*—(1.) If 120lb. per ton be a sufficient tractive force to draw a load on a level road, then the force necessary to draw the load up an incline of 1 in 30 will be 120lb. + $\frac{1}{30}$ of 2240lb., because 120lb. is the force exerted in drawing the load 1ft. on the level, and $\frac{1}{30}$ of 2240lb. is the additional work exerted in lifting the load $\frac{1}{30}$ of a foot. Therefore, 120lb. + $\frac{1}{30}$ of 2240 = 194·66lb.—Ans. (2.) We must in this case find the work the engine is capable of exerting: 6 tons weight of engine + 20 tons load = 26 tons × 0·02 = 0·52, the amount of work the engine exerts in pulling the load and itself in foot-tons. Because the incline is 1 in 100, the additional power is 22·4lb. per ton, and equals 0·01. Therefore, if we add 0·02, the tractive force, and 0·01 together, we get the amount of work expended per ton in drawing our load up the incline. Dividing 0·52 by 0·03, we get 17·3 tons as the total weight drawn, minus 6 tons weight of engine = 11·3 tons load. —BURLEY, Dewsbury.

FILLING TANK.—If a tank has two pipes so fitted that it can be filled in either thirty-five minutes by one, or in an hour by the other, and if the discharge pipe will empty it in half-an-hour, how can the time be found that it will take to fill the tank when all three pipes are open?—INVENT.—*A.*—If we take the tank when full to contain unity, we have each minute $\frac{1}{35} + \frac{1}{60}$ of water flowing into the tank; at the same time water is being discharged at the rate of $\frac{1}{30}$ of the contents of the tank. Therefore the time taken will be: — $\frac{1}{35} + \frac{1}{60} - \frac{1}{30} = \frac{12}{420} + \frac{7}{420} - \frac{14}{420} = \frac{5}{420}$ = 84mins. — BURLEY, Dewsbury. — *A.*—Referring to "Invent's" question *re* filling tank, the following formula may prove useful:—Let V = volume of tank. The first pipe fills tank in 35min. = to $\frac{1}{35}$V in 1min. Second pipe fills tank in 60min. = $\frac{1}{60}$V in 1min. ∴ tank will be filled in 1min.:— $\frac{1}{35}$V + $\frac{1}{60}$V = $\frac{12}{420}$V + $\frac{7}{420}$V = $\frac{19}{420}$V. Third pipe discharges in 30min. = to $\frac{1}{30}$V = $\frac{14}{420}$V in 1min. ∴ $\frac{19}{420}$V − $\frac{14}{420}$V = $\frac{5}{420}$V is amount in tank in 1min. Now let X = number of minutes for filling tank, and we have $\frac{5X}{420}$ = 1; 5X = 420; X = 84min.—H. St.

ECONOMISER SCRAPERS.—What means must I adopt to renew some broken scrapers in the middle of the range of pipes in the economisers?—PUZZLED.—*A.*—I can quite appreciate the querist's difficulty. If there is one thing more tedious than another in repairing fuel economisers, it is the rescrapering of the pipes when no provision has been made at the time of fixing for such repairs. I presume the economiser "Puzzled" is desirous of fitting new scrapers to is fixed in the usual antiquated fashion of section after section, with neither deflector passages nor transverse spaces. If so, I think the best manner of procedure would be to pull down, as far as requisite, that portion of the front wall opposite the broken and useless scrapers, and so endeavour to reach the place for the renewal. The distance will in all probability be too great to, reach with the arm, and if so, a stick of wood should be procured—say 4ft. long by 1½in. square,—at one end of which insert two suitable nails, so that the new scraper can be securely conveyed, suspended between the nails, to the desired spot, and then carefully worked into position on the scraper bar; of course, I do not include the spiral form of scraper in the above method. If "Puzzled" should not quite grasp the idea from the foregoing, I shall be pleased to make him a sketch. What are required with fuel economisers are greater facilities for inspection, cleaning, and especially repairing, and I am pleased to see that the Sykes's Improved Fuel Economiser Company Limited, Manchester, are taking a step in the right direction by giving 8in. pitch longitudinally, instead of the old 7½in. centres, which not only allows the engineer or inspector to get his arm between the pipes for any adjustment of the scrapers, but it also gives the soot from the pipes far more scope to fall between the bottom boxes into the pit than before. The soot that accumulates on the bottom boxes has a great tendency to "jam" the scrapers, and it is from this cause that I consider the majority of scrapers are thrown out of adjustment.—INSPECTOR.

Prize Competition.

WE OFFER FOUR GUINEAS MONTHLY IN PRIZES FOR THE BEST ORIGINAL ARTICLES SENT IN ON ANY MECHANICAL, ENGINEERING OR ELECTRICAL SUBJECT.

IN ORDER THAT MANAGERS, DRAUGHTSMEN, FOREMEN, AND WORKMEN WHO HAVE HAD NO PRACTICE IN WRITING MAY NOT HESITATE TO SEND IN COMPETITIONS, IT IS TO BE UNDERSTOOD THAT ALL ARTICLES WILL BE FULLY EDITED AND CORRECTED, AND JUDGED OF SOLELY ON THEIR MERITS AS ORIGINAL CONTRIBUTIONS FROM A PRACTICAL POINT OF VIEW. THE OBJECT OF THE COMPETITION IS TO INDUCE PRACTICAL MEN TO COME FORWARD AND GIVE THE RESULTS OF THEIR EXPERIENCE.

CONDITIONS.

Competitions for our Monthly Prizes must be sent so as to arrive at the Manchester Offices of THE MECHANICAL WORLD, New Bridge-street, not later than the last Tuesday in each month. Articles arriving after that time will be placed in the following month's competition

Written competitions must be on one side of the paper only. The contributions must be original, and relate to matters connected with Engineering, Mechanism or Electricity.

The Proprietors of THE MECHANICAL WORLD reserve the right to publish any competition, whether it gains a prize or not.

The competitions may be accompanied by diagrams, sketches or drawings.

Competitors should write the words "Prize Competition" on the envelopes.

Competitors are not confined to one, but may send any number of competitions.

The correct name and address of the sender *must* be distinctly written upon every competition, not necessarily for publication. Competitions can appear under a *nom de plume*.

☞ We cannot undertake to be responsible for any MSS. sent to us, though when stamps are enclosed for the purpose we will endeavour to return rejected contributions.

Latest Inventions.

APPLICATIONS FOR LETTERS PATENT.

When Patents have been "communicated," the name of the communicating party is printed in italics.

Where complete specification accompanies application, an asterisk is suffixed

22nd August, 1892.

15,090 BRACE DRILL. J Miller

15,091 PAPER TWINE MACHINES.* G L Brownell.

15,095 APPARATUS for REGULATING the ADMISSION of AIR and STEAM to FURNACES for the PREVENTION of SMOKE.* J K Broadbent.

15,096 METALLIC PACKING for PISTON RODS, VALVE SPINDLES, ETC., of LAND and MARINE ENGINES. H Brewer.

15,097 RIMERS. W Lees, jun.

15,099 BOLT and ROD-CUTTING MACHINES. W March.

15,104 STEAM FIRE and OTHER PUMPING ENGINES. J C Merryweather and C J W Jakeman.

15,107 CHAIN or SPROCKET WHEELS. W Biddles.

15,112 NUT and CATCH for FISH PLATES. C Duffield.

15,114 APPLIANCES for PRODUCING VISIBLE LETTERS or DESIGNS in the AIR for ADVERTISING and SIGNALLING PURPOSES. T S Young.

15,115 RAILWAY RAILS. G Brockelbank.

15,119 APPARATUS for PREVENTING RAILWAY ACCIDENTS and ENSURING the SAFETY of TRAVELLERS on RAILWAYS.* J M Laffas.

15,120 ELECTRICAL ACCUMULATORS or SECONDARY or STORAGE BATTERIES. H W Headland.

15,122 APPARATUS to be USED in the MANUFACTURE and STORAGE of INFLAMMABLE GAS.* W H Beck. (*Benja de Lissa*, Australia.)

23rd August, 1892.

15,124 APPARATUS for HEATING and COOLING LIQUIDS. G H Richmond.

15,132 "MORRIS" FOG and DANGER SIGNAL APPARATUS for RAILWAYS. J H T Morris.

15,140 FURNACE DOOR OPENER.* D Curry.

15,141 RECIPROCATING SAWS. J Andrew.

15,146 APPARATUS for the MANUFACTURE of METALLIC WASHERS. R W Anderson.

15,148 MACHINES for MAKING SPIRAL SPRINGS.* P Fraser.

15,154 WIRE KNOTTING MACHINES.* P Fraser.

15,157 NEW SYSTEM of PLACING RAILWAY SLEEPERS for CARRYING the RAILS. T Whitehead.

15,153 MEANS for SECURING the TUBES of BOILERS and CONDENSERS. C N Wadia.

15,161 ROTARY CUTTING TOOLS. T Sowerbutts.

15,163 MULTITUBULAR BOILERS.* B J B Mills. (*A Coignet*, France.)

15,170 ELECTRO-MAGNETIC ALARM APPARATUS. B Hoffmann.

15,171 VALVES for STEAM ENGINES. T T Tucker.

15,173 FACILITATING the EXPANSION and CONTRACTION of the TUBES in TUBULAR BOILERS. T Vernon and J A Sillars.

15,187 WORKING and REGULATING GLOW LAMPS. A E Le Rossignol.

15,188 ELECTRIC ARC LAMPS. E F H H Lauckert.

15,194 TELEPHONE TRANSMITTER. E L Mayer and A C Jameson.

15,195 RAIL JOINT.* G G Stacy.

15,196 WAVE-POWER MOTOR. C Strutt.

24th August, 1892.

15,205 STEAM-BOILER FURNACES for the CONSUMPTION of SMOKE and ECONOMY of FUEL. J Boyes and T Kelsall.

15,206 EXTRACTION of GOLD from ORE. J D Gilmour.

15,213 GAS LIGHT INTENSIFIER. J T Guthrie.

15,225 ELECTRIC CONTACT LAMP.* C A J H and H E R Schroeder.

15,235 GAS ENGINES. W James.

15,238 TELEPHONIC SWITCHING APPARATUS.* A R Bennett.

15,240 JOINTING or JUNCTION BOXES for ELECTRIC CABLES or WIRES. H Tyler and Co. and C P Hammond.

15,245 STEAM COCKS. W T Sugg.

15,247 GAS ENGINES. E F Piers.

15,250 ROPES for the TRANSMISSION of POWER. J H and J H Bek.

25th August, 1892.

15,259 FURNACE GRATES and BARS. W Shearman.

15,262 CONSUMING SMOKE and SAVING FUEL. E J Rothwell.

15,269 STONE-BREAKING and CRUSHING MACHINES. S Mason.

15,271 SELF-ACTING LUBRICATING APPARATUS for the AXLES of COLLIERY CORVES. A Wood.

15,284 CASTING MOULD ATTACHMENTS. H Hill and Sons and others.

15,285 PRODUCTION of a FERRIC PREPARATION for the PURIFICATION of SEWAGE. C A Burghardt.

15,289 FURNACE for HEATING MALLEABLE IRON or STEEL. T Ray.

15,296 ELECTRICAL ACCUMULATORS. H C Bull and J Ramage.

15,298 HOLDERS for INCANDESCENT ELECTRIC LAMPS. F Bryan.

15,301 BOILER.* R Müller.

15,302 FIRING of MARINE BOILERS.* R Müller.

15,303 PROCESS of ANNEALING WIRE in WIRE DRAWING. K J Mayer.

15,308 STEAM SUPERHEATING APPARATUS.* L Uhler and H Cadische.

15,309 MARINE PROPELLERS.* G J Stevens.

15,316 WRENCHES. J Manning.

15,319 ELECTRIC BATTERIES. D Federman.

15,322 PISTONS. T Jellinghaus.

15,323 MEANS for OBTAINING MOTIVE POWER. J Gemmell.

26th August, 1892.

15,327 HOT-AIR ENGINES. J Southall.

15,329 GAS, ELECTRIC LIGHT, and LAMP FITTINGS. E Horton.

15,347 PISTON-RING PLIERS. E J Davies and S Ward.

15,348 COMPOSITION for COATING BOILERS or IRON or STEEL WORK GENERALLY. J W Longbottom and A Sharman.

15,349 DOUBLE-ACTING HAND or STEAM STEERING GEAR. P Wallace.

15,356 ELECTRO-CHEMICAL PROCESS for TREATING IRON PYRITES. H C Bull.

15,337 RAISING, HOLDING, and DISENGAGING GEAR for BOATS CARRIED by VESSELS. W Harper.

15,371 COMBINED RAILWAY SLEEPER and CHAIR. F Groves and F Deare.

15,372 IMPROVED METHOD of OBTAINING ELECTRICITY. W Boggett.

15,376 AUTOMATIC TELEGRAPHY. F O Clapcott.

15,377 SWITCHES for ELECTRIC LIGHTING. R L Hattersley.

15,383 RAILWAY SIGNALLING. J Moon.

27th August, 1892.

15,399 APPARATUS for SUPPORTING RAILWAY WAGON COUPLING LINKS. D B Morison.

15,402 OPERATING the SWITCHES of TRAMWAYS and LIGHT RAILWAYS. A Winter.

15,403 IMPROVED MEANS for OBTAINING MOTIVE POWER. J Gemmell.

15,405 TELEPHONE SWITCHES. H Oppenheimer.

15,414 STEAM BOILERS. W P Thompson. (*H. Knappe*, Germany.)

15,417 ENGINES in WHICH the POWER is OBTAINED from PETROLEUM or OTHER HYDROCARBONS. J E Weyman.

15,418 GLAND ADJUSTMENTS for the FITTINGS of SCREWED TUBES. J Chisholm.

15,426 ELASTIC COMPOUND for ELECTRICAL INSULATION. J W Savage.

15,437 MAKING ELECTRIC CONTACTS BETWEEN PARTS of ELECTRICAL APPARATUS. W E Gray and W A Price.

15,441 ARC ELECTRIC LAMPS. A J Howes.

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FRIDAY, SEPTEMBER 16TH, 1892.

Technical Paper Advertising.

THAT the results of trade and scientific paper advertising are much better than those of general advertising is no longer open to question. The readers of newspapers and magazines of general circulation attach at best but secondary importance to the advertising columns. Only those who have more than average leisure or are actively searching for information concerning a particular article carefully peruse the advertisements. In the case of engineering papers the situation is widely different. A dealer would regard as disappointing a publication void of advertisements. To him the advertisements are of the utmost importance, and frequently contain news which he directly turns to account. The man who buys a morning newspaper, as a rule, has a single purpose in his purchase. He seeks by obtaining such a paper to inform himself of the doings of the preceding day. He who takes a trade paper seeks as diligently the news of the trade, and also, what is equally vital to him, information of the persons from whom and the places from which he may obtain novelties and necessaries for his stock. To him it is important to know what is being produced for his benefit, and when he has perused the reading columns he does not lay the paper aside but carefully examines the advertisements. The secret of the superiority of technical paper advertising lies in the fact that every copy goes into the hands of a possible buyer, and as the readers are always in want of something directly in the line of its advertisements, business is sure to result if the circulation is genuine; but it is necessary to be sure of this, otherwise no end of money may easily be thrown away. The ratio of results to given circulation is naturally greatly in favour of trade papers. In proportion to circulation THE MECHANICAL WORLD is far and away cheaper than any other journal of its class.

Tin Mining in the Malay Peninsula.

MR. LEECH, an official in Perak, in a recent report describes a new method of tin mining which is being adopted in that State. He says the system of mining in Kinta during the last year has completely changed, owing to the introduction into general use of short wash-boxes. Up to the end of 1890 they were hardly known; now they are used everywhere. The wash-box employed formerly was 30ft. long, and could only be used with a considerable head of water; a 6in. steam pump could only keep two boxes going, and, as a natural consequence, only land in the neighbourhood of large streams of water, or in which the owners could afford steam or water-power pumps, could be worked. Considerable capital was, therefore, necessary to open a mine, and the only part of the land worth washing was the karang or rich tin deposit, found at a depth of from 10ft. to 50ft. below the surface. The introduction of the short wash-box has changed all this. The box itself is but 8ft. long, and costs about 16s. It can be put up wherever there is a pool of water, instead of requiring a steam pump; it can be supplied with water by one man ladling with a kerosene tin, and, instead of thousands of dollars being spent on stripping the surface soil before the karang could be reached, the surface soil itself is now washed in the new boxes, the same water being used over and over again, and the mining coolies earning from 1s. 3d. to 12s. 6d. a day each. Five or six men work to one box. Owing to the small quantity of water used under this system thousands of acres of land which were formerly looked upon as unproductive are now being worked, and the amount of payable mining land in Kinta has become practically inexhaustible.

Launch of the "Campania."

ON the 8th inst., one of the new Cunard liners, the "Campania," was launched from the Fairfield yard on the Clyde. More than ordinary interest attended the event, as not only is it anticipated that the vessel will reduce the time of the Atlantic passage to about five days, but at the same time the "Campania" has the distinction of being the largest vessel afloat. Her dimensions are:—Length over all, 620ft.; breadth extreme, 65ft. 3in.; depth from upper deck, 43ft.; gross tonnage, about 12,500 tons. The vessel has a straight stem and elliptic stern, topgallant forecastle and poop, with close bulwarks all fore and aft, the erections above the upper deck consisting of two tiers of deck-houses surmounted respectively by the promenade and shade decks. The vessel has been built under a special survey, and will take her place in the highest class at Lloyd's. The bulkheads, sixteen in number, are in excess of the recommendations of the recent Board of Trade Committee on the fitting and spacing of watertight bulkheads, and they will enable the vessel to float with any two, or in some cases three, of the compartments open to the sea. In addition to these qualifications the Admiralty requirements for armed cruisers in times of war have been complied with. The construction of the vessel at the stern is peculiar. Although fitted with twin screws, there is an aperture in the stern frame similar to that in a single-screw steamer. This is provided so that the propellers may work freely, though they are fitted close to the centre line of the ship in order to prevent damage to or from the quay walls. No struts are fitted at the stern frame to support the outer end of the shafts as in most other twin-screw steamers. These are in the present case dispensed with, and the frames of the hull are bossed out and plated over right aft to form the stern tubes. At the outer ends of these strong castings of steel serve the purpose of shaft brackets, and being in continuation of the lines of the hull are calculated to offer the least resistance to free propulsion. The "Campania" will be fitted with two sets of triple-expansion engines, the combined power of which will be 30,000I.H.P. Each set will have five inverted cylinders—two high-pressure, one intermediate-pressure, and two low-pressure, the high-pressure pair being above the low-pressure ones. These are arranged to work on three cranks set at an angle of 120° from each other, and all have the same stroke. The high-pressure cylinders are each fitted with a piston valve, the intermediate and the low-pressure ones with double-ported slide valves, all of which are worked by the usual double eccentrics and link motion valve gear. The reversing engines are of the steam and hydraulic direct-acting type, made by Messrs. Brown Brothers and Co., Edinburgh. The reversing engines are also fitted with their patent automatic emergency gear. The crank shafts, which are all built, are interchangeable, and, like the tunnel and propeller shafting, are of mild steel, forged by Messrs. Vickers, Sons and Co. Limited, Sheffield. The condensing water is circulated through the condensers by four large centrifugal pumps, each driven by an independent compound engine. These pumps may also, if required, be used to pump water from the ship in case of damage to the hull. An elaborate system of piping is fitted throughout the ship and connected to the various auxiliary pumps for filling and emptying the ballast tanks, pumping out bilges, pumping water on deck in case of fire, and other purposes. In the engine room are also four evaporators to produce the necessary fresh water from sea water, and thereby make up the loss incurred through working and avoid the use of salt water in the boilers. There is also a large feed-water heater, two auxiliary condensers with pumps, and all the most modern appliances to economise fuel and labour. Steam for the main engines is generated in twelve large double-ended boilers. There is also a large single ended boiler, for supplying steam for the electric light, refrigerating and other auxiliary machinery. In addition, a small single-ended boiler will be fitted on the lower deck for supplying steam to the distilling condensers, heating pipes, etc. The main boilers are arranged in two groups, having one funnel for each group. It is anticipated that the "Campania" will take her place in the Atlantic service next spring.

Improved Cargo-raising Appliance.

A NEW CRANE, specially devised for loading and discharging cargoes, has recently been perfected by Mr. J. H. Morgan, of Liverpool. The apparatus consists of two main parts—namely, the crane proper and the grabbing and holding appliance. The crane is of the ordinary description, having a barrel and chain attachment for hoisting and lowering. The novelty consists of an ingenious arrangement for working the grabbing apparatus. This consists of a movable frame carrying a chain which runs on the same barrel as the crane chain, but this is the only connection between the two parts of the machine as a whole. The frame is connected with the piston of a steam cylinder, and can be raised or lowered at the will of the attendant. A downward movement of the piston actuates a lever, which causes a pair of hinged grabs to clutch and hold the goods tightly until they are deposited in the required position. On raising the piston the hold on the lever is slackened, and this causes the grabs to release their load. The goods thus deposited can then be handled by the labourers on the quay or in the ship, as the case may be, while the crane swings the grabs over for another load. The special point about these grabs is that they are of seven different kinds, having been designed by Mr. Morgan to deal with various classes of goods. There is first an elevator bucket for dealing with grain, salt, and similar cargoes; then there is an appliance for dealing with tea-chests and small boxes, of which some 30 can be taken at each lift. The sack and bale lifter deals with this class of packages without risk or injury to their contents. Another form of grab is capable of lifting timber in logs and deals, and iron in rails, bars, and plates. Besides these there is an open bottom capsizing bucket for materials that cannot be efficiently dealt with otherwise, and there is a coal tipping wagon and a stone gripper. All these appliances can be successively attached to and worked from the same crane, each being removed and replaced by the other as circumstances require.

Light Electric Motors.

THE remarkable success of the Lauffen-Frankfort rotary-current installation, in connection with the Electrical Exhibition held at Frankfort last year, has led to an extraordinary statement, made in a recent issue of the "Genie Civil," by M. Marcel Delmas. As this gentleman states, the progress of aërostation is hampered by the lack of a suitably light motor; but this, it must be admitted, is not the only important point to consider, there being that of navigating the atmosphere. The Frankfort experiments proved, says M. Delmas, the possibility of transmitting along a thin light wire a current at the exceedingly high tension of 30,000 volts. The danger which such a pressure offered was, he states, diminished by the use of polyphase currents. We are almost inclined to ask, What next? As a matter of fact, the success was really due to the exceedingly careful manner in which the installation was carried out, and particularly to the use of double oil insulators. M. Delmas suggests that polyphase machines might be used for military purposes in connection with semi-captive balloons, instead of captive balloons, the current to be transmitted by thin light wire. We are afraid that M. Delmas has omitted to take into consideration the question of transforming down the current in the balloon; but apart from that, there is no necessity for the employment of very high-pressure current for such purposes, and it is not easy to understand how there could be any material diminution in weight by the use of either continuous, alternating, or polyphase machines.

Recent Boiler Explosions.

(*Continued from page* 59.)

REPORT No. 552 refers to an explosion of a boiler on board a coal barge, the crown of the combustion chamber and furnace collapsing through shortness of water, which was undetected owing to the bottom water gauge being choked. That the gauge opening should be blocked up is not surprising, as the engineer stated that "he had to run as long as he could until something happened, when the boiler would also be attended to." This is, in our opinion, a serious case, the boiler not having been examined except casually by the engineer, who does not appear to have had a certificate. The chief engineer attributes the explosion to incapacity or neglect of the engine-driver.

No. 553 refers to the bursting of the jacketed portion of the valve chest of a low-pressure cylinder. It appears that the engine was not developing its full power, and someone altered the governor arrangement, which allowed a greater pressure to pass into the chest and jacket than was at first intended. One man only was injured.

No. 554 refers to the failure of the packing or jointing material used in a badly fitting manhole. Many marine boiler manholes are not well made to commence with, and the engine-drivers (they cannot be called engineers) are either ignorant or careless as to the jointing material used. We have often pointed out the importance of good fitting joints, and thin but good jointing material. With faced joints a smearing of white lead and a ring of twine is all that is wanted, but with rough unfaced joints even ⅛in. diameter engine packing only makes a rough and dangerous packing.

No. 555 inquiry dealt with the failure of the screwed eyebolt into which the cross-bar of a manhole cover of a still was secured. The still was used in the manufacture of ammonia, and does not appear to have been fitted with a safety valve. The eyebolt, however, showed traces of its having been fractured at some time when it could not well have been discovered.

No. 556 reports the breaking of a junction valve, due to the excessive vibration set up by the engines racing during very bad weather. Fortunately no one was below at the time, or serious scalding would have been the result.

The Construction and Efficiency of Boilers of Locomotive Engines.

(*Continued from page* 99.)

In Fig. 10 a typical American boiler is illustrated. This boiler was made by Messrs. Burnham, Williams and Co., at the Baldwin Locomotive Works, Philadelphia, U.S.A. The boiler barrel is telescopic, 5ft. in diameter at the smokebox end and 5ft. 6⅛in. at the firebox end; it is built in three rings, each ring consisting of two plates ⅞in. thick. The upper plate

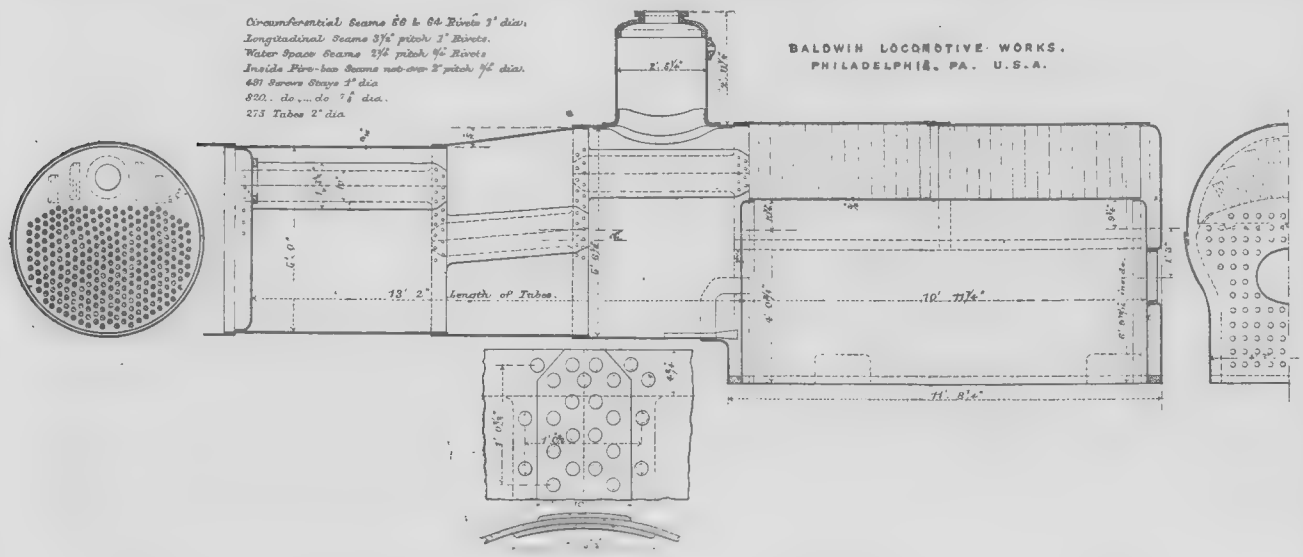


Fig. 10.

of the large ring next to the firebox is flanged out to receive the dome, which fits over the outside of the lap formed by the flanging. In the construction of this boiler steel is used throughout, with the exception of the dome cover, which is of cast iron. The firebox shell is made in three pieces, which are ⅝in. thick, and are joined with double-riveted laps. The top of the firebox is rigidly attached to the shell with 491 screwed stays, 1in. in diameter. The water space between the firebox sides and the shell tapers from 3in. at the foundation ring to 6in. at the top of the box. The firebox is stayed to the shell at the sides, back, and front with 820 screwed stays ⅞in. in diameter. The boiler is stayed longitudinally with gusset stays. There are 275 tubes 2in. in diameter, giving a heating surface of 1883·75sq. ft. The heating surface in the firebox is approximately 166sq. ft. The grate area is 39sq. ft. The boiler supplies steam at a working pressure of 150lb. per sq. in. to cylinders 20in. in diameter and 24in. stroke, which, neglecting clearance, have a capacity of 15,076·8in. The ratios are as follow:—2·68 cubic in. of cylinder capacity to 1sq. in. of grate area, 1 cubic in. of cylinder capacity to 17·99sq. in. of tube heating surface, and 1 cubic in. of cylinder capacity to 19·5sq. in. of total heating surface. There are several points in the design of this boiler open to criticism—among others the extensive use of lap joints in the firebox and shell, aggravated by the rigid staying of the same. It will be observed that in the American boilers the firehole, instead of being supported as in English locomotive practice by a ring of heavy section, has the back firebox plate and the back plate flanged inwards and lapped over. Owing to the fact that this hoop is not circular, the joints, due to the compression of the firebox crown and side plates and tension on the back plate, have a tendency to groove; and owing to the abrasive action of the shovel the bottom part of the firehole, unless well protected, will wear away very quickly.

The largest locomotive made by Messrs. Burnham, Williams and Co. is illustrated in Fig. 11. Considering that this boiler is designed for the standard gauge of 4ft. 8½in., it may be looked upon as a masterpiece of mechanical ingenuity. With the exception of the dome cover, it is made of steel. The barrel, which is 6ft. 2in. in diameter, is built in three rings, each ring being made of two plates ⅝in. thick; and the longitudinal seams are covered with inside and outside butt strips, which are treble-riveted on each side of the joint. The boiler has 281 tubes 2¼in. in diameter, giving a heating surface of 2219·9sq. ft.; and supplies steam at a working pressure of 160lb. per sq. in. to cylinders 22in. in diameter and 28in. stroke, giving a capacity of 21,280·6 cubic in. The following ratios obtain in this example:—4 cubic in. of cylinder capacity to 1sq. in. of grate area, 1 cubic in. of cylinder capacity to 15sq. in. of tube-heating surface, and 1 cubic in. of cylinder capacity to 15·77sq. in. of total heating surface.

(*To be continued.*)

Methods for the Prevention of Smoke.

A committee of the Engineers' Club of St. Louis, U.S.A., have prepared a report on the prevention of smoke. Their chief object was to find a cure for the nuisance from which that and many other cities

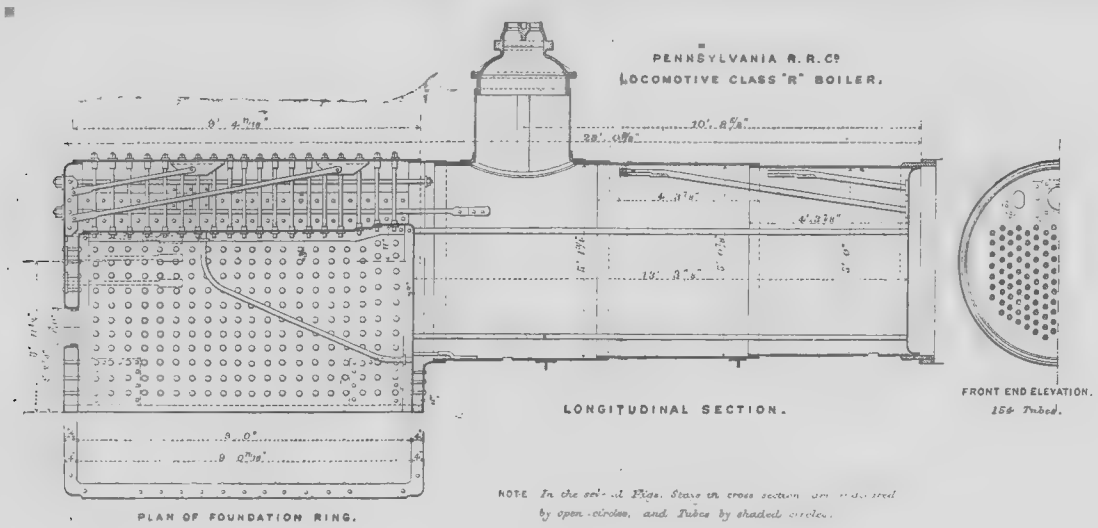


Fig. 11.

suffer, and the part of the report dealing with mechanical devices for the prevention of smoke in boiler furnaces is of great general interest.

The committee made inquiries of 78 manufacturers who used local bituminous coal, and only seven were found to be using smoke-preventing apparatus. Of these only one seemed to be quite satisfied with his apparatus, and he was his own inventor. Nineteen others reported that they had tried preventers in former days, but had thrown them out for various reasons.

A smoke preventer, in order to be popular, must prevent the separation of the unconsumed carbon particles; it must be cheap and easily applied to any existing furnace; it must not increase the consumption of fuel; it must keep right automatically in spite of great variations in the amount of work it has to do and in spite of inattention on the part of the fireman; it must not occupy too much space; it must not be liable to derangement, nor must it want repairing often; and it should not stop the natural draught. There are numberless inventions, all claiming to attain these desired ends. They can be classed under seven different heads, as follows:—Steam jets, firebrick arches, hollow walls for preheating air, coking arches or chambers, double combustion, downward draught furnaces, automatic stokers. All these methods are efficient in a way, but the perfect application and combination of them has not been discovered as yet.

Steam Jets.—This class of apparatus is intended for injecting an induced current of air into the fireplace over the fire. The steam heats the air and aids the combustion of the coal, and when the heat of the coal is great the steam is decomposed by contact with it into hydrogen and carbonic oxide, both of which afterward burn and aid the combustion of the coal. These jets can be made to work satisfactorily where the demand upon the boiler is comparatively light and does not vary much, but it is necessary to supplement their action with careful and regular firing. If too much coal is charged in the fireplace at a time, the temperature is likely to be so much reduced that the action of the jets tends to retard rather than promote combustion. Such a system is, therefore, largely dependent for its successful operation upon the skill and faithfulness of the fireman. It often happens also that with careless handling the amount of steam used in the jets more than offsets any gain in efficiency due to improved combustion. Another very important consideration is the setting and adjustment of the nozzles, which, if not very carefully attended to, may be the cause of a blowpipe action upon the boiler shell or grate bars resulting in a rapid burning of the metal, especially from the strong oxidizing action of the decomposing steam.

Firebrick Arches.—These are usually fixed at the back of the furnace near the bridge, and serve to store heat. As the gases pass under them their heat raises the temperature of the gases, and thus makes the combustion more complete. There is also a modification of this system sometimes used, and that is to subdivide the passage through the arch into a number of smaller passages, and so increase the heating surface. The firebrick arch and its modification are efficient with careful firing, but they require too many repairs and renewals; also they stop the natural draught considerably.

Hollow Walls for Preheating Air.—A great many patents have been brought out in this line, but none of them work. By this means heated air is introduced at the bridge and round the furnace, but the openings are readily clogged and injured.

Coking Arches or Chambers.—This system consists in constructing a chamber in front of, or in an arch over, the forward part of the fireplace; the fresh coal is charged under this arch and retained there until the greater part of the volatile matter is driven off. The resulting coke is then pushed to the rear to serve as the hot bed over which the volatile matter from the fresh coal in front is made to pass. These devices are only effective when the fireman is careful in working the fire, and when the amount of coal to be burned in a given time is limited. Such constructions are necessarily short-lived, as they are exposed to high heats, changing temperature, and fluxing ashes.

Double Combustion.—Applications of this system have been attempted in many ways. Some have taken the form of duplicate fireplaces, which are charged with fresh coal alternately. Suitable dampers or valves cause the smoke and gases from the freshly-charged grate to pass beneath and thence through the other fire bed, which consists in the main of glowing coke. The double furnace requires extra room, and also requires more skill and attention than can be expected from an ordinary fireman. None have proved successful.

Downward Draught Furnaces.—These consist essentially of a fireplace with the back closed so that there is no direct communication for the smoke and gases to pass away under the boiler except downward through the fire bed. The closed back is formed either of a water leg from the boiler which passes below the level of the grate, or a drum set below the level of the grate and connected at either end with the boiler by tubes, the space between the drum and the bottom of the boiler shell being bricked in solid. Owing to the intense heat upon the grate, it is necessary to substitute a water-tube grate for the ordinary bars, and these water tubes are connected at the back with the water leg or drum and at the front, by means of headers and connecting tubes, with the boiler shell. All these parts, therefore, belong to the water-circulating system of the boiler, and supply so much additional heating surface. The combustion of the fuel is effected, by such a device, in a far more rational way than on the ordinary fire bed. The fresh coal is as usual charged on the top of the bed, but the air enters from the top, and, therefore, cooler part, quickly gaining heat from contact with the heated coal, and passing with the smoke and distilled volatile matter through the bed of incandescent coke below. In order to get the requisite amount of opening for draught the water tubes forming the grate must be spaced at a greater distance apart than is the case with ordinary grate bars. Some of the fuel will, therefore, drop through, impelled by the force of the draught added to that of gravity. With caking coals the loss from this source is not great under moderate firing. When, however, the fires are pushed and frequently worked with a bar to loosen the mass of caked coal or to clean the grate, a considerable amount of coal falls through. This has led to the adoption of an auxiliary grate of ordinary type set some distance below, and through this the air is delivered for the combustion of the gases issuing below the upper grate. As the lower grate receives only the incandescent fuel falling from above, the space between the two grates is in a favourable condition for completing the combustion, being highly heated and supplied with heated air. The downward-draught system is well adapted to the prevention of smoke, even when the fire is forced or when there is a careless fireman. It is easily attached to any boiler, and it increases the heating surface of the boiler. There are many objections to all the designs hitherto made on this system. They might easily, however, be removed. The arrangement for admitting air to the lower grate through the floor plates in front of the boiler is defective, as it does not permit of the control of the air current; excessive quantities of air enter and cause an unnecessary heat and a lowering of the efficiency. The water tubes of the grate and the connecting pipes are liable to

unusual strains at the joints. The water leg or drum, which acts as an inverted bridge, is subjected to intense heat, and the same may be said of the tubes of the water grate. Unless the circulation is very efficient indeed, the scale which might deposit at these places would cause the metal to be eaten through by the heat very soon.

Mechanical Stokers.—In this form of apparatus the coal is fed mechanically through the closed firedoor regularly and gradually, and the grate is constructed in such a manner that the charge is pressed slowly forward by the feed. As the coal enters, the bituminous portions are distilled off and the resulting gases pass over the incandescent fuel behind. This apparatus would be very efficient with coal that does not cake and does not form clinker, but unfortunately most of the Illinois coal has this drawback. Then, again, the mechanical stoker cannot be forced to meet an emergency.

Engineering Pattern Making.

By A Foreman.

XXIV.

The next subject is tin and plaster work, a branch of pattern making in which timber generally forms but a small item, and where the pattern maker should have a fair knowledge of modelling in clay so that he may produce in this material leaves, fruit, animals or any other figures that may represent a portion or the whole of an artistic design. These, when reproduced in plaster of Paris, will form the pattern from which tin sections are cast, and when built up constitute the master pattern or the working pattern for the moulder.

This particular class of pattern making is in most demand in foundries where ornamental stove and grate work, fenders, etc., are made, and where plate moulding takes the place of the ordinary method, as being specially applicable when a large number of castings are required, and which may be produced by less skilled labour, and consequently at a greatly reduced cost. A number of patterns may be set side by side, or in any convenient position, and the "git," in the form of a spray connecting each piece or pattern, set on the plate as shown at Fig. 161, thus saving the cutting of a channel for the metal in each mould. The first part of this sub-title is somewhat misleading, as the pure tin is not used, but forms a part of an alloy consisting of three parts of lead and one of tin. The introduction of the latter, like antimony in type metal, is made for the purpose of sharpening the corners and giving cleaner edges to the "chased" pattern. The more general, though somewhat ambiguous, term for this alloy, is "compo" metal, tin being the name used for it in Scotland, whilst lead is the term employed by our Yorkshire artisans.

The low melting point and extreme malleability of the alloy specially fit it for this class of work, as it admits of being "cambered" or "set," so that an iron pattern or casting made from it will have, in turn, the proper amount of "set" in any direction to ensure a straight casting or produce a required deflection.

Plaster of Paris is gypsum or sulphate of lime, which by heating loses its water of crystallisation, is then ground to different degrees of fineness, and is known as building, modelling, and dental plaster. The second named is the kind usually employed, being sufficiently fine to take an impression of any lines or figure that could be practically transmitted to moulding sand. In order that this particular branch may be clearly understood, we propose to take as one of the examples an ornamental grate—one of those artistic designs which have become so popular, and which require a combination of art and craft for their production.

By referring to Fig. 162 it will be seen that the design consists of different sections relieved with panels, the latter being made from a plaster cast run on the modelled clay, or if convenient cut out from a design on paper gummed on a thin slab of plaster, and varying in thickness to suit the reliefs. This is usually adopted when the design requires to be reversed, tracings being made from the original drawing and attached to the plaster slabs; though, if the liquid plaster be run on the modelled clay, a matrix is formed which will serve for further use on other designs, and which, when prepared by giving a coat of shellac, varnish, or linseed oil, will allow of a number of plaster patterns to be cast from it for insertion in modified or extended designs.

Modelling in clay is perhaps the most attractive portion of the work, as we express ideas and form the subject by means of our fingers and a few tools. The material is soft and pliable, and is prepared for this purpose by grinding and by freeing the same from stones and grit of any description, thus giving it a uniform plasticity throughout.

We shall now refer to the tools used in forming and finishing the materials employed in this class of work, as, being different from the ordinary wood pattern, the same implements as used in the general

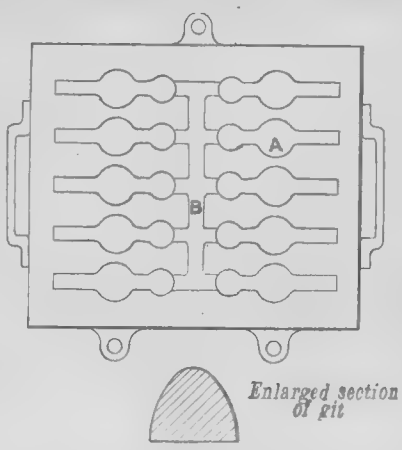


Fig. 161.

shop would have to be supplemented by a few boxwood modelling tools and "floats" of different shapes as shown at Fig. 163.

These, in conjunction with a few others which are often made to suit some particular class of work, constitute the principal instruments used by the modeller in the finishing of his work. With the modeller the fingers take the place of the gouges and chisels as used on the timber, the clay being pressed and moulded by them to within a close approach of the

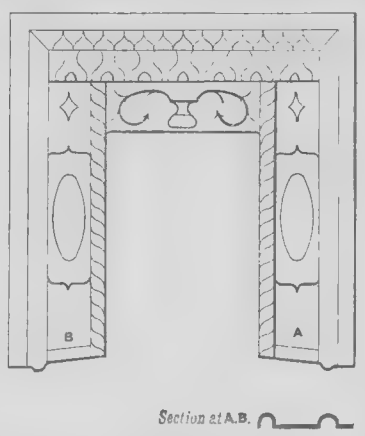


Fig. 162.

finished subject, the tools herewith shown being used as smoothers to remove any little superfluity and impart the finer lines to the figure. Most of the castings made in iron or brass are relieved of their superfluous weight by either coring or cutting away the back part of the pattern, the requisite strength being maintained by webs or stays cast at convenient distances. The first method of lightening the casting or pattern from which it is made is not applicable where the figures stand in relief,

Fig. 163.

as in a panel or medallion; and the means by which a plate of uniform thickness can be made with the corresponding depressions from a pattern with a flat back, and which process is called in this class of work "embossing," will be given further on.

(To be continued.)

Mem. for Advertisers.—The charges for advertisements in The Mechanical World are less than half those of any other engineering journal in proportion to circulation, and not one-eighth the price of some of its competitors.

Notes on Brass-foundry Practice.*

The object of the present paper is to give a few general remarks on alloys and other processes as carried on in brass foundries at the present day. Appended is a table giving the composition of alloys in everyday use in brass foundries, with a description of the work for which they are made, or suitable for :—

	Copper	Zinc.	Tin.	Lead.	Phosphorus	Aluminium.	
	lb.	lb.	lb.	lb.	lb.	lb.	
Admiralty metal	87	5	8	—	—	—	For parts of engines on board naval vessels.
Bell metal.....	16	—	4	—	—	—	Bells for ships and factories.
Brass (yellow)..	16	8	—	½	—	—	For plumbers, ship, and house brass work.
Common bush metal	64	8	4	4	—	—	For bearing bushes for shafting.
Gun metal.....	32	1	3	—	—	—	For pumps and other hydraulic purposes.
Hard gun metal	16	—	2½	—	—	—	For heavy bearings.
Manganese bronze.....	85	5	6	5man	ganese	copper	Metal for propellers.
Muntz metal ..	60	40	—	—	—	—	Metal from which bolts and nuts are forged, valve spindles, etc.
Phosphor bronze.....	92	—	8 ph	osph	or tin	—	For valves, pumps, and general work.
Phosphor bronze.....	90	—	10 ph	osph	or tin	—	For cog and worm wheels, bushes, axle bearings, slide valves, etc.
Naval brass	62	37	1	—	—	—	Used by the Admiralty for bolts, nuts, etc.
Brazing metal..	16	3	—	—	—	—	Flanges for copper pipes.
Brazing solder..	50	50	—	—	—	—	Solder for the above flanges.
Aluminium brass	60	40	—	—	—	2	For large spindles, etc.

In making the manganese bronze or the aluminium brass, the manganese copper or the aluminium should not be added to the other metals in the pot till the last moment, and should be cast immediately afterwards.

In making moulds for manganese bronze, dry sand is preferable to greensand. The gates and feeders should be very thick, and attached to the thickest part of the mould. The same remark applies to Delta metal as regards the gates and feeders.

Some greensand moulds require to be skin-dried before casting. This is generally done by holding a red-hot plate over the mould. A better way, especially for deep moulds, where the heat from the plate could not penetrate so well, is to pour a little naphtha over the mould, and apply a light. When the flame arising from the ignited naphtha burns itself out the mould will be ready for casting. Gates attached to the top of a mould are more advantageous than the ordinary side gates, as they take up less room, less metal, are easily chipped off, and save the casting from shrinking on the top. If plunk gates are used in greensand moulds, the moulds must be dried to prevent scabbing.

In casting long, thin, ornamental setplates for ships, the number of gates required to run them are generally heavier than the casting, and this causes the plate to crack at different places. To prevent this, it is best to have one or two men standing by, so that the top side of the moulding box may be lifted immediately after the metal is poured in, and then with the point of a shovel the gates are broken off from the casting while they are still in a soft, pasty condition.

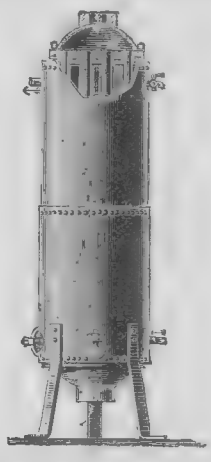
In making cores for lubricators, piston valves, or other cores which have a large body with small ends, it is difficult at times to get them properly vented. By spreading some loose cinders, about the size of small peas, along the sides of the core wire in the large part of the core, and drawing the vent strings over these, the air freely escapes and prevents blowholes in casting. It sometimes happens that a round bush is wanted immediately for a breakdown job, and for which the moulder has not a core the required size in stock—say, 6in. diameter and 9in. long. The speediest way to get such a job done is to get a piece of iron or brass plate a little smaller than the diameter of the core, bore and tap a ½in. hole in centre, screw a piece of rod iron into this hole, and, having dipped it in clay wash, lay inside of corebox, place a 2in. tube over the rod iron, resting it on the plate, and ram up a greensand core; and having withdrawn corebox and tube, which acts as a vent hole, the core can be lifted by the iron rod without any fear of it breaking, and fitted in the mould. The rod is then withdrawn before closing the top side of box.

The application of one to three coats of coal tar has been recommended for rendering masonry waterproof, the addition of a little rubber dissolved in benzene giving the coating increased durability. When the colour is objectionable, the freshly-tarred surface may be dusted with plaster of Paris.

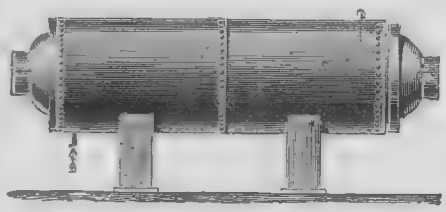
* This article has been awarded a prize in our Competition.

Feed-water Heaters.

The Grantham Crank and Iron Company Limited, of Grantham, have recently introduced a simple form of feed-water heater which is made in both horizontal and vertical types, of each of which an illustration is given. The shell is of mild steel, and the tubes, which are straight, are of brass. The latter are fixed at one end and fit freely into the two heads at the other end, as shown in the sectional view. These heads are countersunk and provided with packings, which are compressed by screwing down the crown, and which readily allow the



tubes to expand and contract. In the vertical type the exhaust steam enters at the top of the shell, and passing down through the tubes, leaves the heater at the bottom as indicated by the arrows. The feed-water enters the shell at the bottom and is taken out at the top to the boiler. There is no necessity for bent tubes, nor for one tube inside another, and back pressure is thus avoided. It should be noted that beyond the saving of fuel which a good feed-water heater ensures there is also a considerable economy resulting from the purification of the water, and the consequent prevention



of scale. There is no doubt that feed-water heaters will be largely used in the near future, and such a simple and efficient apparatus as that under consideration is, therefore, worthy of the attention of steam users generally.

On Shipbuilding in Portsmouth Dockyard.†

Portsmouth Dockyard.—The members of the Institution of Mechanical Engineers will find much to interest them in the shipbuilding and engineering departments of Portsmouth Dockyard. At the same time they cannot fail to be impressed by the fact that the establishment exists, and has its scale and character determined, by the circumstance that it has been for centuries, and still remains, our principal naval arsenal. For nearly seven centuries Portsmouth is known to have been one of the

† Paper by Mr. William H. White, C.B., F.R.S., read before the Institution of Mechanical Engineers.

headquarters for the national fleet. In 1212 the sheriff of the county of Southampton was ordered to enclose the King's docks by a strong wall, and to provide suitable storehouses. A dockyard properly so-called was founded thereby Henry VIII., coming next after that at Woolwich, which was closed in 1869; so that Portsmouth yard is now the oldest as well as the most important in existence.

Growth of Dockyard.—Like the Royal Navy itself, the yard had a modest beginning and a slow development. In 1540 the total area is said to have been about eight acres. Until nearly the end of last century there was no basin in which ships could lie while completing or undergoing repairs, and the docking accommodation was poor. In the face of much opposition, and largely on the initiative of General Bentham, what was thought a great extension was carried out in the closing years of last century. A basin about 2½ acres in area, and six dry docks adjoining it, were constructed. These are still in useful work. Dwarfed though they are by subsequent extensions, these additions to the dockyard were admirably conceived and executed. Only a few years ago the "Victory," Nelson's flagship, was undergoing repairs in the yard, and her presence in the basin and dock gave an object-lesson on the sufficiency of the scale on which the work was done for the utmost demands thought possible a hundred years ago. To Bentham also was largely due the introduction into the dockyards of steam power and mechanical improvements of various kinds, including sawmills, metal mills, pumping appliances, etc. Other able men, amongst them the elder Brunel, aided in this movement; and the famous block-making machinery devised by Brunel dates from this period. At the end of last century the yard had an area of 90 acres, and was capable of building and repairing the largest classes of warships. For forty years there was little change.

The development of steam propulsion for warships necessitated the next great change during the period 1843 50. A steam factory, with all proper adjuncts, including engine and boiler shops, foundries, etc., was then added to the yard. Another basin, 7 acres in area, and four docks capable of receiving the largest ships of the period were constructed. By 1850 the area of the dockyard had reached 115 acres, an increase of rather more than one hundred acres in three hundred years. So far the development of warship building had left the materials and structural arrangements practically the same as early in the century, and the five building slips on the harbour front were still capable of use in the construction of ships of all classes and of the largest size. In the latest of the screw line-of-battle ships a full sail equipment was retained, and the character and arrangement of the armament were little changed from the days of sailing ships.

With the introduction of armour plating and iron hulls a new era of rapid development began. Sail power was diminished or abandoned. Greater steam power and higher speeds were introduced. The old smooth-bore guns and their simple carriages gave place to rifled guns of greater weight and power, with mountings of novel design. Ships became larger in dimensions and more complicated in structure and equipment. Auxiliary machinery of all kinds—steam, hydraulic, and electrical—was introduced, either to perform operations formerly done by manual power or to meet new requirements. All these and many other changes, to which reference cannot here be made, have necessitated corresponding changes in the plant and workshops of the dockyards, and have involved large expenditure.

There was a short period, from 1859 to 1869, during which Portsmouth fell behind Chatham and Pembroke in its equipment for iron shipbuilding, and in the scale of its operations. In 1869, however, orders were given to lay down at Portsmouth the "Devastation" turret ship, which was the first iron-hulled armoured vessel built here Since that date the old standing of the yard as a first-class shipbuilding establishment has been fully restored. A complete and extensive plant has been installed in convenient positions near the slips and docks where ships are built. New workshops and stores have been erected for electrical work, torpedoes and torpedo apparatus, gun mountings, etc. In short, the dockyard has been made capable of meeting all requirements in the construction and equipment of ships of all sizes and classes.

Shipbuilding in Docks.—In one particular, present conditions compare unfavourably with past. Formerly there were five building slips, three of which were capable of receiving the largest class of ships then built. Now there is only one large slip suitable for building first-class armoured ships, and another suitable for ships of moderate size. On the other hand, docks are available, and are made use of, for building the largest ships. The "Centurion" will be seen now building in the dock from which the "Royal Sovereign" was floated out in the presence of Her Majesty the Queen. Experience shows that when docks are available it is advantageous in many ways to use them for building ships. The risks and expense of launching are avoided; the work of construction is simplified, especially in dealing with heavy weights, such as armour plates; and economy is rendered possible in various directions. It is recognised, of course, that a plan such as this, while reasonable enough in a dockyard with ample dock accommodation, is not applicable in private establishments generally. One eminent shipbuilding firm, however, works on similar lines, having the good fortune to possess docks. Alone among the contractors for the first-class battleships now building, Messrs. Laird, of Birkenhead, are constructing the "Royal Oak" in a dry dock, and will not float her out until she is far advanced towards completion, with hull armour fixed and engines erected on board.

Latest Extension.—The latest and grandest extension of the dockyard to meet the new conditions was commenced rather more than twenty-five years ago, and is now nearly completed. It includes three enclosed basins, having a total area of 50 acres, in which the largest ships can lie afloat; a tidal basin of 10 acres; five large docks, three of which are in use, and two are being completed; and two entrance locks, available also as dry docks. The total area of the dockyard has thus been increased to nearly 300 acres. The fitting-out basin is still incomplete. Adjoining it, on Coaling Point, special machinery has been erected for the supply of coal to the fleet. Except at the period when the naval manœuvres are taking place, there may be seen in the basins a large number of vessels, constituting the fleet reserve, ready for service at short notice. Besides these vessels, there may always be seen new ships in various stages of progress, older ships undergoing repairs, and others lying in reserve until they can be taken in hand. Moored in the harbour are many other vessels—some in commission, others in reserve. The squadron of royal yachts; the armoured ship carrying the flag of the Commander-in-Chief; the numerous gunboats, torpedo boats, and small craft attached to the gunnery and torpedo schools; as well as the transport and store-ships, are all certain to attract attention. Amongst the reserve ships are many famous vessels, but none more beautiful or more worthy of admiration than the first seagoing ironclad, the "Warrior." The "Victory" remains to show what line-of-battle ships were a hundred years ago. Specimens of the screw three-deckers may also be seen, shorn of their masts and spars, but even thus left impressive by their height and bulk. In fact, nowhere else can be seen such an epitome of the history of shipbuilding for the navy as is constantly on view at Portsmouth.

New Construction.—This brief glance at the history of the dockyard and the range of its work has been taken in order that a fairer appreciation may be gained of the conditions under which new construction must necessarily be carried on here. Important as this section of the work undoubtedly is at all times, and specially important as it has become in the last three or four years, it still has to be subordinated to the requirements of the fleet. Sudden and exceptional demands from the fleet in commission have to be met even in time of peace; more serious demands must be made when war is being waged. These are the conditions which necessarily govern the scale and character of the establishment, influencing largely the arrangements of workshops, plant, basins, and docks. Great as are the resources of the yard for shipbuilding, and large as are the provisions for engineering and manufactures of special kinds, these are necessarily overshadowed to some extent by arrangements growing out of fleet requirements. Unavoidable difficulties have therefore to be faced in connection with new construction as compared with the facilities existing in private establishments of recent date, created solely for the construction of ships and machinery. When inspecting the dockyard, members of the Institution will not fail to remember these essential differences; and they will make due allowance for its antiquity, for its gradual development, and for the enormously rapid changes in naval material and equipment during the last forty years, which have revolutionised the shipbuilding and engineering departments.

New construction falls chiefly upon the shipbuilding department of the yard, of which the Chief Constructor is the principal officer. In recent years the manufacture of new machinery and boilers for ships of the navy has been undertaken to a limited extent in this department. New engines and boilers have been made for the "Rupert," now undergoing a thorough repair, their aggregate horse-power with natural draught being 4500. The engines and boilers for the second-class cruiser "Fox," now building at Portsmouth, are also being made in the yard; they will develop 7000 H.P. with natural draught, and 9000 H.P. with moderate forced draught. This new course has been taken by the Admiralty for special reasons, which have led also to a certain amount of new machinery and boilers being made at Devonport, Chatham, and Sheerness. The steam factories at the dockyards, however, are chiefly engaged in the repairing of machinery or boilers, and the making of new boilers. As a rule the machinery and boilers for new ships have been obtained from the leading marine engineers of the country, and this policy is still acted upon.

The engineering departments at Portsmouth and the other yards do a large amount of new work in manufacturing torpedo tubes and special apparatus of various kinds, which in the public interest it is considered preferable not to have made by contract. Such apparatus is necessarily experimental in the earlier stages; and the bulk of this experimental work, in connection with gunnery as well as with torpedo fittings, has fallen upon Portsmouth, this port being the headquarters for the gunnery and torpedo schools of the fleet. The first electrical workshop under the Admiralty was organised in the Chief Constructor's department of Portsmouth yard, and has now grown into a large establishment of increasing importance; and all the other yards have now at work electrical departments, the staffs of which have mostly been trained at Portsmouth.

(*To be continued.*)

Shipbuilding Notes.

Messrs Harland and Wolff, shipbuilders, Belfast, are extending their premises. Their boiler sheds are to be enlarged, and a joiners' shop, covering half-an-acre, is to be built.

Messrs. Gourlay Brothers and Co., Dundee, launched on the 7th inst. a steamer for Messrs. W. Thomson and Sons, Dundee Her dimensions are:—360ft. long, 44½ft. broad, and 29ft. deep.

There was launched on the 5th inst., from the shipbuilding yard of Messrs. John Scott and Co., Kinghorn, a screw steamer, which has been built to the order of the Leven Steamship Company Limited, Methil. She is 153ft. long, 23ft. 3in. beam, and 11ft. 6in. deep.

On the 8th inst. the steamer "Sagamore" was launched from Messrs. Harland and Wolff's shipbuilding yard, Queen's Island, Belfast. Her dimensions are:—430ft. long, 46ft. broad, and 35ft. deep, and her gross tonnage is 5280. The engines, which are triple expansion, were supplied by the builders.

The launch of Her Majesty's ship "Theseus," one of the high-speed cruisers laid down under the Naval Defence Act, took place at the Thames Iron and Shipbuilding Company on the 9th inst. The "Theseus" is of 7350 tonnage, with 12,000 H.P.; length, 360ft.; width, 60ft.; depth, 23ft. 6in. She is to have a speed of 20 knots.

Messrs. Alexander Stephen and Sons, shipbuilders, Dundee, intend shortly to lay down what will be the largest sailing ship ever built in Dundee. The vessel will be constructed of steel and iron, and her gross tonnage will be about 3000. This is 500 tons greater than that of the "Galena," which was launched from Messrs. Stephen's yard about two years ago.

Messrs. R. and W. Hawthorn Leslie and Co. Limited, Hebburn-on-Tyne, launched on the 8th inst. a large steel screw steamer for the Anglo-Australasian Steam Navigation Company, of London. The vessel's dimensions are:—372ft. by 43ft. by 29ft. The triple-expansion engines supplied by the builders have cylinders 30, 48, and 78in. diameter, by 54in. stroke, steam being supplied by two double-ended and one large auxiliary boiler, working at 160lb. pressure.

Messrs Laird Brothers launched from their works at Birkenhead, on the 7th inst., the torpedo gunboat "Onyx," for Her Majesty's Government. The vessel has a length of 230ft., with a beam of 27ft. and a depth of 14ft. 3in., her displacement being 810 tons. She is fitted with two sets of independent triple-expansion engines, capable of developing 3500 I.H.P., the cylinders being 22, 34, and 51in. in diameter, by 21in. stroke, and working at a pressure of 150lb. The armament consists of two 4·7in. guns, four 3-pounder guns, and several torpedo tubes.

Carbons.*

It was suggested at one of our committee meetings that I should prepare a paper for this convention on "Carbon Testing," but the time was too short to carry out a series of experiments as at first spoken of, so instead I have prepared a short description of the process of manufacture of carbon points, as conducted at the factory in Peterborough.

Carbon is an elementary substance, occurring in nature uncombined, as the diamond and mineral plumbago. It is much more abundant, however, in a state of combination; thus it occurs in union with oxygen in the carbonic acid present in the atmosphere, and in combination with oxygen and calcium forms in the shape of limestone a large proportion of the earth's crust. In union mainly with hydrogen, it is the chief constituent of coal and mineral oils, and along with oxygen, hydrogen, and nitrogen, is an abundant ingredient of animals and still more so of plants. It exists in several allotropic forms—that is, forms which differ from each other in many physical and some chemical properties, but which nevertheless consist of nothing but single elements.

Wood carbon, or charcoal, is prepared by heating wood in iron retorts as long as it evolves anything volatile. When coal is treated in the same manner, as it is in the manufacture of coal gas, the excess of carbon is in like manner left behind, forming a hard shining light solid, valued as an economical and powerful fuel. This substance, which is literally charred coal, and therefore best deserves the title of charcoal, goes nevertheless by the name of coke. A variety of this material is found in the upper parts of the gas retorts, and is probably formed by the decomposition of gaseous compounds of carbon and hydrogen. It is very hard and porous, with almost a metallic lustre, and is a great conductor of heat and electricity; but this is of little value, if any, in the carbon business. However, 25 per cent. of this coke mixed with 75 per cent. of petroleum coke is said to make a good carbon for low-tension work. Another variety of this material is obtained from the oil regions, commonly known as petroleum coke. This is a by-product of the oil stills, and is the only kind used to any great extent in the manufacture of carbon points for the electrical industry. It is of primary importance that the coke, and in fact all the ingredients used, be absolutely free from impurities. Sulphur, iron, and dirt (by dirt I mean shale, sand, and other foreign matter which by careless handling may get in) are the impurities frequently met with, but sulphur is by far the worst the carbon maker has to contend with; but by using the very best of coke which is obtained from Pennsylvania oils, trouble from this source is reduced to a minimum. The other constituent of our carbon is pitch. This is made from coal tar, which is a by-product of the gas retorts. It may also be obtained from blast furnaces, but this kind is more or less contaminated with iron, and therefore is unfit for this class of work. Pitch for this particular purpose is difficult to obtain, as the makers do not care to expose their still to the high temperature necessary to drive out all the oil, and reduce it to the proper specific gravity; and as the men in the factory say, "It is more or less wet."

The first step in the process of manufacture is that of crushing the coke. This is accomplished by means of a machine somewhat in appearance like a mammoth coffee mill. The coke comes from this crushed to about the size of coarse gravel; it is then automatically elevated to a large bin in the upper part of the factory, and from there it is conveyed to a large iron hopper situated directly over the calcining retorts. Into these the granulated coke is conducted by means of spouts with gates arranged to control the flow of material into the several aforementioned retorts. They are then sealed up, thereby preventing combustion, with the exception of a few vents to allow of the escape of gas arising from the heating of the coke to a state of incandescence, which point is reached in from 24 to 48 hours after firing. After this, if the coke is not pure it will be found to have caked, necessitating in some cases the use of bars to break it up sufficiently to allow of it being drawn from the retorts. If pure it will appear crisp and dry and to have suffered a loss in weight of about 30 per cent. After retorts have been drawn sufficiently long to allow of cooling, their contents are elevated to the milling department and run through a set of French buhr stones encased in iron, very similar to the grist mill chop stones; then through a silk bolter,

* A paper by H. O. Fisk, read at the annual meeting of the Canadian Electrical Association.

separating the coarse from the fine, the former returning to the milling machine, the latter being conveyed to bins with suitably-arranged spouts, over scales, from which it may be drawn and weighed as required by the mixing department. We will leave the coke here for the present and return to the other ingredient—namely, the pitch. This is a dense, hard solid, very brittle and dry, and in appearance somewhat resembling gutta-percha. This material, when it reaches the factory, is encased in casks holding about 600lb. each. It is then broken up by the men into a convenient size for handling, and subjected to a granulating process similar to that of the coke; finally we find it at a spout close beside the one from which the coke is drawn.

We have now followed the two principal ingredients through the various processes which were necessary to prepare them for the mixing room. The other ingredients, if any, we shall not be able to elaborate upon until we have reached a more confidential relationship with the carbon makers. However, upon the manipulation of the materials at this stage I am told the success of the future carbon greatly depends; in fact, the great secret lies in the mixing. We can better understand the skill and care required to properly amalgamate the mixture when we learn that each particle or grain of coke must have its individual coating of pitch, and it may be interesting to learn that this coke is ground so fine that a grain magnified a thousand times would only appear the size of a shot. To obtain these results the materials are carefully proportioned by weight and placed in a mixing barrel. This is a rotating cast-iron cylinder within which in the same direction revolves an independent shaft, twice as fast as the cylinder, to which are attached arms so arranged that every part of the barrel is covered or swept in each revolution. This is attached to a furnace in such a way that the flues follow the whole circumference of this barrel, maintaining a uniform temperature of about 300° F., which is necessary to bring the pitch to a state sufficiently plastic for amalgamation. Thirty minutes is the time required for each batch, which would make about 1600 carbons. From this machine it is taken to the cooling room, and spread out for 10 or 12 hours to cool. Here the mixture solidifies to such an extent that it becomes necessary to pulverise it again to perfect it for the moulds. This end is attained by means of a mill, the pulverising elements of which are two discs 30in. in diameter, with corrugated faceplates revolving in opposite directions at the rate of 1500 revolutions per minute (about $\frac{1}{100}$th of an inch apart). From this it is once more passed through a bolting machine, and then, finding its way down gravity tubes to a bin on the floor below (which is the moulding room), it is carefully weighed out by the workmen on peculiar little scales with clock-like dials, in quantities just sufficient to fill each mould as it comes hot from the oven. Having been previously lubricated with some heavy oil, it is now ready for its charge, which the operator places in it and works evenly over the whole surface with a spatula, to ensure uniformity of density. The cover or top half is placed in position and the mould and its contents pass for a few moments into an oven, the temperature of which is about 300° F. As soon as the mixture has become quite adhesive the mould is placed in the hydraulic press, and subjected to a pressure of several hundred tons. This press consists of a cylinder and base, kept in position by four steel columns weighing nearly a ton each. Within this cylinder (which is 11in. thick and copper lined) is a ram or plunger 13in. diameter, making a stroke of 3in. Connected with this press by a feed and return pipe is a triple cylinder pump very powerfully geared, pumping a stream of water continuously through the feed pipe, press cylinder, and return pipe. , By simply closing the valve at the press on the return pipe, the pressure at once begins to accumulate under the ram, and in 15sec. the enormous pressure of 20,000lb. per sq. in. is attained. Then the release valve is opened, and the whole apparatus, as though possessed of life, gives a groan of relief. The mould is now removed and opened, and we have a corrugated card containing 16 or 18 carbons, each one being joined to its neighbour by a fin, which is inevitably formed when subjected to the enormous pressure before mentioned. These cards are placed on plates which are fitted to receive them perfectly. These plates, with their contents, are piled up, and weights placed thereon to prevent warping. When cool they are broken apart, gauged for size, culled, and the fin scraped off. They are then laid in the furnace for baking. This furnace is retangular in shape, 34ft. by 11ft., 4ft. deep, and made of firebrick, and is similar to a large vat set about two-thirds below the surface of the earth. Over this, when filled, is placed a dome-shaped cover, sufficiently high above the sand and tile which cover the carbon to allow of a free passage of the flames, and which is continued by flues back through the sides and also underneath, thus completely enveloping the body of the furnace in flames. The carbons are carefully placed in the furnace, and separated from each other with washed sand, which is brought from the shores of Lake Ontario. Some days are required to completely load a furnace, as each section will hold about 75,000 carbons. The cover having been placed in position and sealed with fireclay, the fire is now started, crude oil being the fuel used, as well as in the case of the retorts and moulders' oven. The supply is held in a 250-barrel tank by a railway siding some 200ft. from the building, and connected by underground pipes to the various points in the factory where required, each branch terminating in a patent burner, which to the writer very much resembles a huge lineman's torch, with the exception that steam is used to spray the oil and perfect the combustion. This fire is continued moderately for 48 hours, to allow of the gas escaping without blistering the carbon; it is then forced to its utmost for from 48 to 60 hours longer, then shut off, and the whole allowed to cool for 48 hours before uncovering. The top, which is mounted on wheels, is then rolled off, and a few carbons taken from various parts of the furnace and tested by a Wheatstone bridge and galvanometer for resistance, as this at once determines if the baking has been carried sufficiently far. If the measurements of all the samples exceed four-tenths of an ohm, the furnace is re-covered and fired for some hours longer; but this very rarely has to be done. The writer recently tested samples from the north and south end and centre of a furnace, and they measured 23, 22, and 24 one-hundredths of an ohm respectively. Some difficulty was at first experienced in attaching carbon to the bridge, for the resistance of this substance, as you are all well aware, varies considerably, as the pressure of contact, and the same carbon measured at different times would often vary several hundredths of an ohm. But an instrument was designed by the writer which obviated to a great extent, if not wholly, this trouble. The pressure brought to bear on the sample undergoing test by this instrument is determined by small weights suspended from levers attached to holders so arranged that exactly the same pressure and contact are formed on different samples of the same size. If the resistance of the samples as before mentioned shows that the contents of the furnace have been sufficiently baked, it is unloaded, the hot carbons being handled with forks. When cold they are sorted, the firsts and seconds being easily determined by rolling on level steel plates.

After this inspection they are ready for the plating room, where they receive their copper coat by being hung in leaden vats containing a saturated solution of sulphate of copper. These vats, of which there are several dozen, are connected in series with a 20-ampère constant current dynamo. Twenty minutes to half-an-hour is the time required to complete this plating process They are then washed in hot and cold water and placed on racks to dry, after which they go to the packing department to be rolled in paper and boxed for shipment.

I am indebted for a great deal of the above information to Mr. Taylor, the genial manager, who not only patiently answered my many questions, but allowed me, with camera, perfect freedom throughout the entire factory, thus enabling me to obtain and show photographs of some of the apparatus, which will give a far better idea of the same than the meagre description you have just listened to.

The Utilisation of the Energy of Flowing Water.

(*Continued from page* 81.)

THE pressure of flowing water upon a blade may be compared to that of wind upon a sail, and it is seen that in a moderate breeze a sailing ship carries a large spread of canvas, but the vessel is propelled only at the same speed as may be attained with a much smaller sail area in a higher wind.

It may also be noticed here that sailing vessels of large size, exposing enormous sail area—up to 50,000 sq. ft. and upwards,—are still built, that they are easily handled and successfully compete with steamers in many trades.

As far as the authors are aware, the floating wheel is the only current machine requiring no permanent works which is in actual use. This is merely an undershot wheel, generally of antiquated design, slung between two barges moored in the stream. The blade area exposed to the water is very limited, mainly from practical considerations of size and weight of the wheel, and rarely exceeds 15sq. ft.; and, in consequence, the machine is only to be found on rapid streams, as parts of the Rhine, Danube, Douro, and the like. Even under the best conditions the power to be obtained from it is very small. The most effective speed for the paddles is found to be about half the velocity of the current, and as the wheel moves in the same direction and away from the water impinging on the paddles, the wasted energy is very large. Being convinced that the essential conditions of any practical improvement in floating current motors are:—

(1) That the sectional area of stream entering the machine should be large;

(2) That the line of motion of the blades or paddles employed should not be in the direction of the stream,

The authors designed and had constructed an experimental motor which was moored in the tideway of the Thames at Woolwich, where, in the autumn of last year, a series of tests were made under the direction of Prof. W. Cawthorne Unwin, F.R.S., the distinguished president of this section.

This machine may shortly be described as follows:—Two barges, each 50ft. long by 10ft. 6in. wide, are braced together with an open channel 5ft. wide between them. In this, and above the water level, is fixed an endless iron railway, tilted to an angle of 45° with the horizontal. Round this track travels on wheel carriages a pitch chain, articulated so as to pass easily round the curves at either end. The pitch chain carries 29 blades, each 4ft. wide by 3½ft. deep, 12 of which are always completely immersed in the water under the barges. The barges are moored at an angle of 60° to the direction of the current, and the blades are fixed at right angles to the stream, and at 30° to the direction of motion. The blades are arranged in "echelon," and in this way a blade area 151·6sq. ft. is exposed to the action of the water.

The current impinging on the blades moves the pitch chain, which gives motion to three pitch wheels, also geared together, and these drive an oblique shaft, which again, by bevel wheels, drives a horizontal shaft.

The effect of tilting the track is that, while 12 of the blades are always vertically in the water, 12 are horizontally in the air (as shown on the cross-section), and the remainder are on curves at either end of the track. No provision for feathering is necessary, as the position of the track causes the blades to enter and leave the water in a very perfect manner. The blades, which are flat, have a square lip 8in. deep on the leading edge, and a roof board of the same width on the top.

A large number of tests were made at even intervals of time, and the results carefully tabulated. The velocity of the current was tested by an Amsler-Laffon current meter, and observations were taken every five minutes during the experiments. The power of the machine was measured on a brake wheel, and in a current of 3 miles per hour was found to be 2½ horses, or about 11 per cent. of the total energy of the stream passing the blades.

From the calculations of Prof. Unwin, it appeared that, though no exact theory of such a motor in an open stream can be formulated, the hydraulic efficiency, neglecting friction, might be 32 per cent., so that there was a loss of 21 per cent. due partly to the imperfect action of the water on the blades, and partly to mechanical friction of the chain and gearing.

(*To be continued.*)

Catalogues, Price Lists, Etc.

Engineers, Tool Makers, Metal Merchants and others are invited to forward Catalogues, Pamphlets, Circulars, Price Lists, etc., for notice in this column.

MESSRS. W. H. SPENCER AND CO., of Hitchin, have forwarded us a copy of their new catalogue of pumps, steam engines, etc. Various forms of duplex, donkey, power and centrifugal pumps are shown, and very full dimensions and particulars accompany the descriptions of each. Some useful hints on fixing pumps are also given. In the steam-engine section some neat and substantial horizontal engines are illustrated; also undertype engines, portable engines, Cornish and Lancashire boilers and accessories. Some useful hydraulic memoranda are appended, and several pages are left blank, forming space for notes, etc. The catalogue is neatly printed and carefully prepared.

Messrs. BARRATT, WOODSON AND CO. have sent us a leaflet giving particulars of their Universal Friction Paste for driving belts and bands. It is claimed that the paste preserves the material of the belt, and that it increases the frictional grip, whilst it contains nothing injurious to leather, such as resin, glue, acids, etc. The material is used by a large number of firms, whose names are given in the circular, together with several excellent testimonials.

From Mr. WALLACE BENTLY, Crossley-street, Halifax, we have received a copy of a pamphlet containing a number of questions in machine construction and drawing, and intended for students preparing for the Science and Art examinations. Most of the questions are original, and generally they are of a character suitable for elementary and advanced students.

Trade Notes.

Messrs. McMillan and Sons, Dumbarton, have secured an order for a screw steamer of 2000 tons.

By a Ministerial decree Russian railway companies must in future order all their rolling material at home.

Messrs. Siemens and Halske, of Berlin, have recently completed an electric lighting plant at Grosetto, Italy.

The Highland Railway Company are constructing four powerful locomotives at their works at Lochgorm, Inverness.

The Friedrichdorf Ironworks, Vienna, have secured the patent rights of the Cornwall-Mört boiler, and have commenced their manufacture.

Messrs. William Denny and Brothers, Dumbarton, have contracted with a Liverpool firm for a large steamer for the cargo and passenger trade.

The Royal Electric Company, Montreal, have received an order from the Montreal Passenger Railway Company for motors of 25H.P. for eighty cars.

Messrs. Blohm and Voss, of Hamburg, have received an order from the Ballin Shipping Company to construct a large paddle steamer for passenger traffic.

Messrs. L. Franke and Co., of Mannheim, have secured the contract for the electric lighting of several of the principal rooms in the Mannheim Town Hall.

The Shrubbery Sheet Iron Company, Wolverhampton, are about to put down another sheet mill at the Stour Valley Works, and carry out other extensions at a cost of £5000.

Messrs. Thomas Larmuth and Co., Todleben Ironworks, Salford, have supplied a large compound air compressor to the Meyer and Charlton Gold Mining Company, South Africa.

Messrs. Bumstead and Chandler, Cannock Chase Foundry, Hednesford, have supplied the engines and dynamos required for the electric-light installation at St. Helens Town Hall.

Messrs. Vaughan and Sons, of West Gorton, have completed for the electric-lighting station at Huddersfield a large overhead travelling crane, capable of lifting 15 tons. It is to be driven by an electric motor.

Messrs. E. Morewood and Co., of the South Wales Works, Llanelly, have just completed their new steel-making plant, which comprises three high rolls—viz., three rolls one above the other, with regenerative heating furnaces, heated by gas.

The directors of the Brush Electrical Engineering Company Limited recommend a dividend at the rate of 6 per cent. per annum on the preference and ordinary shares, for the six months ended June 30, making 6 per cent. for the year upon both classes of shares.

Messrs. R. and W. Hawthorn, Leslie and Co., Newcastle-on-Tyne, have received orders from the British Admiralty to construct the machinery for three torpede gunboats. They are also in receipt of an order from the Russian Government to supply the whole of the machinery for a twin-screw armoured battleship.

The Congo Railway Company have given an order for 3000 tons of small steel rails, weighing about 45lb. per metre, to an English steelworks in competition with the Belgian rail syndicate. It is understood that the tenders submitted by the four English firms which competed were a few shillings lower than the Belgian firms.

Wheel cutter in metal only. Every description of gearing. R. CHIDLAW, 43, City-road, Manchester.

Having regard to the enormous circulation of THE MECHANICAL WORLD, the Editor suggests that it is by far the best medium for the insertion of every kind of "Wanted" advertisement, and the price is only one halfpenny per word. The Editor will be glad if MECHANICAL WORLD readers will kindly bear this in mind as occasion arises.

Sugar-making Machinery—XIX

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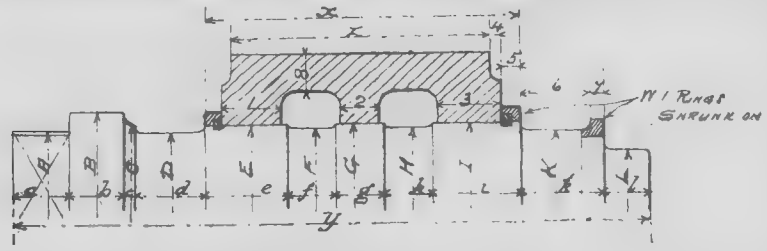
FIGS. 35 and 36 show the construction of sugar mill rollers of the larger sizes, showing the gudgeons and the rings for preventing



SUGAR-MAKING MACHINERY.—FIG. 35.

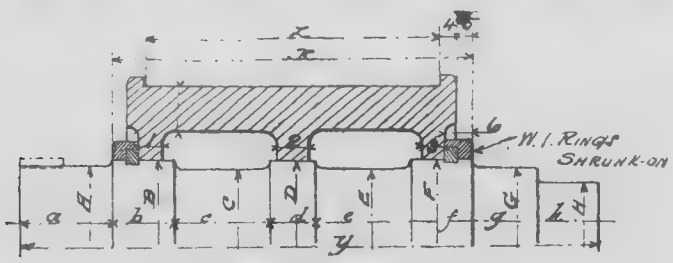
"creep" in the keys, and forming collar on end journals. The inner rings, it may be observed, are square in section and in halves, and are let into the body of the shaft close up to boss of roller, the outer ring

TABLE XIV.—DIMENSIONS OF TOP ROLLERS AND GUDGEONS.

Size of Mill.	in. 20 × 36	in. 22 × 36	in. 24 × 48	in. 26 × 54	in. 28 × 60	in. 30 × 66	in. 32 × 72	in. 34 × 78	in. 36 × 84	in. 40 × 72
A	in. 7½	in. ■	in 10	in. 11	in. 12	in. 13	in. 15	in. 16	in, 16	in. 18½
B	10	11½	14	15	16	17¾	20	21	21½	24½
C	—	—	—	11½	14	16	17	19	19	21
D	7	8	9½	10½	11½	13	14	16	15½	18
E	8	9	11	11½	12½	14	15½	17½	16½	19
F	7½	8½	9½	10⅝	11⅝	13½	14½	16½	15⅝	18
G	—	—	10⅛	11⅞	12⅞	13⅞	15⅞	17⅞	16⅞	18⅞
H	—	—	9½	10⅝	11½	13½	14½	16½	15⅝	18
I	7⅛	8½	10⅛	11⅝	12⅝	13⅝	15⅝	17⅝	16⅝	18⅞
K	7	8	9½	10½	11½	13	14	16	16½	18
L	4	4½	4½	5	6	6	8	8	8	8
a	7½	8	8	9½	9	10	10½	10	11	12
b	8½	10½	12½	13½	15	16½	18½	20½	20½	24½
c	—	—	—	½	½	½	½	½	½	½
d	8	10	12	13	14	14	17	18	18	20
e	11	12	12	14	14	15	16	18	19½	18
f	18	18	12½	13½	16	18½	20	20	21½	18½
g	—	—	5	5	6½	6	7	8½	8	7
h	—	—	12½	13½	16	18½	20	20	21½	18½
i	11	12	12	14	14	15	16	18	19½	18
k	9½	11½	13½	15	16	16	18½	20	20	22½
l	6½	8	10	10	9	11	12½	11	11½	12
x	40	42	54	60	66½	72½	79	84½	90	80
y	80	90½	110	121½	130	140½	156½	164½	171½	171½
1	8	9	9	10½	11	12	13	16	16	14
2	—	—	4	4½	5	5	6	7	7	6
3	8	9	9	10	11	12	13	16	16	14
4	—	7/8	1	⅞	1½	1½	1½	1½	⅞	1
5	2	2½	1×1	2½	2	2	2	1½	2½	3
6	8	10	12	13	14	14	17	18	18	20
7	1½	1½	1½	2	2	2	1½	2	2	2½
8	2½	2½	2½	3	3½	3½	4	4½	5½	5½

being formed to suit, and shr ık on to the half rings to keep them in position.

In these larger rollers the centre of the roller cases are supported by being



SUGAR-MAKING MACHINERY.—FIG. 36.

thickened up to fit a centre hub. The eyes of the roller cases at E, G, I, B, D, and F, Figs. 35 and 36, are bored to varying diameters, varying about ⅛ of an inch, so

TABLE XV.—DIMENSIONS OF SIDE ROLLERS AND GUDGEONS.

of Mill.	in. 20 × 36	in. 22 × 36	in. 24 × 48	in. 26 × 54	in. 28 ■	in. 30 × 66	in. 32 × 72	in. 34 × 78	in. 36 × 84	in. 40 × 72
A	in. 6½	in. 7½	in. 8½	in. 9½	in. 10½	in. 11½	in. 13½	in. 16	in. 14½	in. 16½
B	7½	8½	10	10½	11½	12½	12½	17½	15½	17½
C	6½	7½	8½	9½	10½	11½	14	16½	14½	16½
D	—	—	9⅛	10⅞	11⅞	12⅞	13	17⅛	15⅞	17⅞
E	—	—	8½	9½	10½	11½	13½	16½	14½	16½
F	7⅞	8⅛	9⅜	10⅜	11⅜	12⅜	13	17⅜	15⅜	17⅜
G	6½	7½	8½	9½	10½	11½	13⅜	16	14½	16½
H	4	4½	4½	5	6	6	8	8	8	8
a	16½	21	12	27	29½	30	17	39	39	44
b	11	12	12	13½	14	15	16	18	19½	18
c	18	18	12½	14	16	18½	20	20	21½	18½
d	—	—	5	5	6½	6	7	8½	8	7
e	—	—	12½	14	16	18½	20	20	21½	18½
f	11	12	12	13½	14	15	16	18	19½	18
g	9	11	13½	14	15	15	18½	19	19	21
A	7	8	10	11	10	12	12½	12	12½	12½
x	40	—	54	—	66½	72½	76½	84½	90	—
y	72½	—	101½	112	121	129½	146	154½	160½	157½
r	36½	36½	48½	54½	60½	66½	72½	78½	84½	72½
1	8	9	9	10	11	12	13	16	16	14
2	—	—	4	4½	5	5	6	7	7	6
3	8	9	9	10	11	12	13	16	16	14
4	1⅞	1½	1⅝	1⅞	2	2	2	2	2½	2½
5	½	1⅝	1½	1⅞	1⅞	1⅞	1⅞	1½	¾	1⅞
6	2	—	¾	—	2	—	—	—	2½	3
7	2½	2½	2½	2¾	3½	3½	4	4½	5½	5½

that the gudgeons may be readily entered into place. The keys are generally square keys, let half into shaft and half into

the main dimensions of these rollers and gudgeons.

(To be continued.)

London Association of Foremen Engineers and Draughtsmen.

THE usual monthly meeting of this association was held on Saturday evening, the 3rd inst., in the "A" room of the Cannon-street Hotel. The chair was taken by the president, Mr. F. J. Garnish, and Mr. James Brown, the vice-president, occupied the deputy chair. Designs for the proposed members' certificate were submitted to the meeting and one selected and approved, the Committee being empowered to make arrangements for its production. After the election of new members and other routine business, Mr. William T. Coates, works manager to Peter Brotherhood, Esq., C.E., proceeded to read a paper on "Ships and Guns." Mr. Coates gave a history of our Navy from the time of Alfred the Great—whose successor, Edgar, mustered about 4000 galleys to defend our island against the Danes—up to the present, when in many parts of the world may be seen our floating castles of steel, propelled by engines of enormous power and full of the latest machinery which scientific and mechanical skill can produce.

In describing the transition from wooden to iron-built ships, Mr. Coates drew attention to the "Warrior," the first of our ironclads, as being even now, at the age of thirty, as sound in the hull as ever; and also to a rather curious difference between this ship and the "Black Prince," which was built from identical drawings, and the engines of both vessels constructed by the same firm—Penn and Son. The "Warrior" was, however, and is to this day, superior both in steamng and sailing to the "Black Prince."

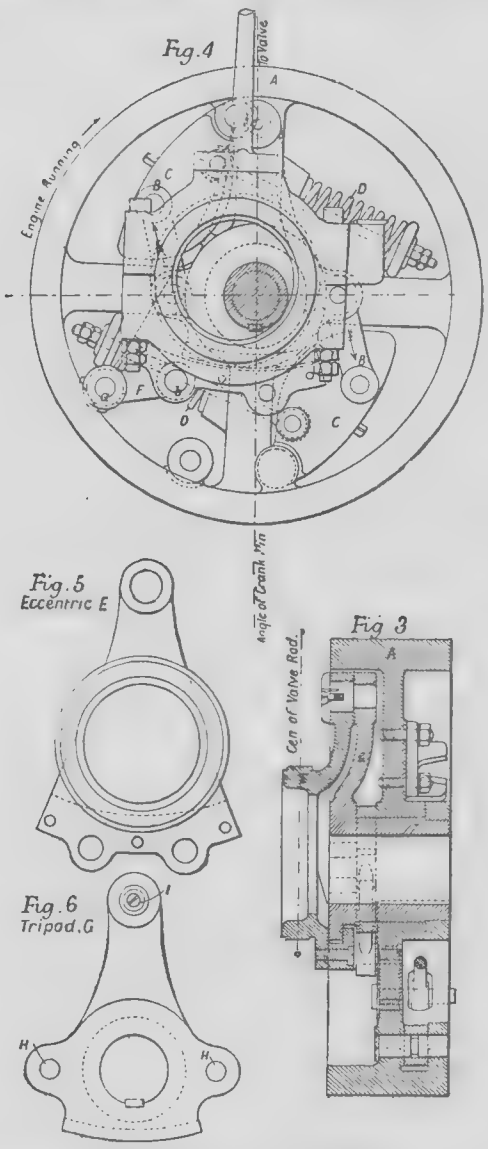
Since the introduction of ironclad ships greater progress has been made up to the present time than had been witnessed for 200 years previously.

Mr. Coates described the size and style of guns used at various periods, and showed that from the time of Elizabeth to the end of the Crimean War the science of artillery might be said to have remained stationary, for although the manufacture of the guns had improved, they still remained the same smooth-bore muzzle loaders, firing badly-fitting round shot, which were about as efficient as snowballs against even 4in. armour. Since the introduction of ironclad ships, however, the improvements in gun making have kept pace with the improvements in shipbuilding, until we have now many guns each firing a shot of greater weight than the whole broadside of the "Victory" at the Battle of Trafalgar. He thought, however, we had reached the limit of size in our guns for the present, and that although it might be necessary to have a few large battleships mounting heavy guns, to act as movable forts, it was more necessary to have a much larger number of smaller ships and guns.

ONE of the latest practical applications of aluminium is found in its use in making railroad carriage window frames. Such aluminium window frames are now made at Neuhaussen, Switzerland.

Moore's Crank-shaft Governor.

THE accompanying illustrations show Moore's patent crank-shaft governor, which is manufactured by Messrs. Marshall, Sons and Co. Limited, of the Britannia Ironworks, Gainsborough. The governor consists of a heavy loose rim, attached to the shaft by an elastic arrangement of links, carrying balls or weights. A is the rim; B C D respectively the links, weights, and spring composing the elastic arrangement; and C the weight, which may be part of the arrangement, as shown. This rim revolves with the shaft, but is capable of running round the shaft to a small extent defined by the limit of extension and contraction of the link centres, or, in other words, by the extent to which the weights will open out; this can be regulated by stops in the back of the weight. In connection with the loose rim of the governor is a variable expansion eccentric, shifting with the rim and causing the valve to cut steam in the cylinder sooner or later, as the case may be. E is that eccentric, and F is the link connecting same with the governor rim. The tripod, or three centres fixed to the shaft, is shown at G. Centres H H are those from which the governor is driven, and I that to which the eccentric at the other end is attached. The action of the governor is as



MOORE'S CRANK-SHAFT GOVERNOR.

follows:—The inertia of the rim assists the weight to raise its momentum, by straightening out link and weight; when speed of shaft diminishes, assists the weights to fall. The momentum of the rim takes the place of gravity in an ordinary governor by assisting the governor to fall; but inertia of the rim does not take the place of gravity in resisting the governor's rise. Thus it will be seen that the governor is assisted both in rising and falling, and not in falling merely, as is the case with an ordinary governor. When the governor is expanding, with an increasing speed, the shaft acts against the rim through the link and weight, as shown by the arrow. When the governor is closing, with a diminishing speed, the rim acts against the shaft, tending to pull it forward, straightening out the link and weight. The weights are maintained in a smaller plane of revolution, so to speak, than that due to centrifugal force, by the governor acting against the inertia of rim when rising—that is, speed increasing. Weights are maintained in a smaller plane of revolution than that due to centrifugal force by the momentum of the ring acting against the governor, tending to pull it forward when closing—that is, speed decreasing. The governor has a tendency to go too far both ways, either up or down, whenever there is the slightest variation above or below the normal speed, which tendency is kept down by the work of shifting the eccentric and valve. It will be seen that this governor has a store of force in the inertia and momentum of rim, ready to act on the eccentric and valve the instant the engine tends to increase or diminish in speed, independent of centrifugal force of balls or weights. This governor has not first to "get up" speed or overrun and accumulate force before it can do the work required of it, as is the case with an ordinary governor; thus the engine is controlled to such a nicety that it practically gives no variation in speed, however the load may change—a factor of the greatest importance in any electric-light or other high-speed machines.

Remarkable Water Powers.

ALTOGETHER the most extraordinary water-power installation—so far as head is concerned—ever known has recently been made by the Pelton Water Wheel Company, in one of the famous Comstock mines, Virginia City, Nevada. The wheel is 36in. diameter, made of a solid steel disc with the buckets riveted on to the periphery in a way to afford absolute security, weighing complete 180lb.

It is running under a vertical head of 2100ft., equal to 911lb. pressure; 460ft. of this head is obtained from the pipe line of the Gold Hill Water Company, and the remaining 1640ft. from the California and Con. Virginia shaft, down which the pipe line is run to the Sutro tunnel level, where the power station is located, and through which the water discharges after passing over the wheel. The wheel runs at 1150 revolutions, with a peripheral speed of 10,804ft. per minute, or about 120 miles per hour.

The construction of the wheel amply provides for the centrifugal strain the velocity of the water gives it, running without load, when it would attain the enormous speed of 21,608ft. per minute, equal to about 240 miles per hour. A nozzle tip ½in. diameter gives under above conditions 100H.P Every miner's inch of water, equal to a flow of 1·6cub. ft. per minute, gives 5H.P., while 1H.P. is given for every 2lb. of metal in the wheel. It is only by comparison that an idea can be obtained

of the height of a column of water due to such pressure. It is more than four times as high as the Washington monument and considerably more than twice the height of the Eiffel tower. It is safe to say that no water wheel has ever before been operated under any such head, nor any such demonstration afforded of the velocity and power of water under such an extreme pressure.

Safety Attachment for Steam Engines.

THE accompanying illustrations show an arrangement designed to automatically stop engines of the Corliss or similar type, when from breakage of the valve spring or other cause an undue increase of speed occurs. Fig. 1 shows a front elevation with the apparatus inoperative, while Fig. 2 represents the position of the parts when the engine is stopped by the safety attachment, and Fig. 3 is an end view. Upon the shaft of the governors A is fastened a short lever B, to the outer end of which is attached an upright knocking-off rod, carrying at its upper end an adjustable finger C. When the speed of the engine becomes unduly high the governor shaft A makes a partial revolution, whereon the arm or lever B lifts the upright rod, bringing the finger C in contact with the bent or cranked portion of the rod D, which is free to turn on its fulcrum carried by the bracket E. As C turns the lever, the other hooked end of the rod D is withdrawn from the hole F in the swan-necked lever G, allowing the latter to turn on its fulcrum under the influence of the weight W until the hollow of the lever encloses the end of the valve lever, as shown in Fig. 2, thus stopping the engine. The device has already been the means of preventing what would in all probability have been a serious breakdown. Mr. R. Ripley, Holme Mills, near Burton, Westmorland, is the inventor.

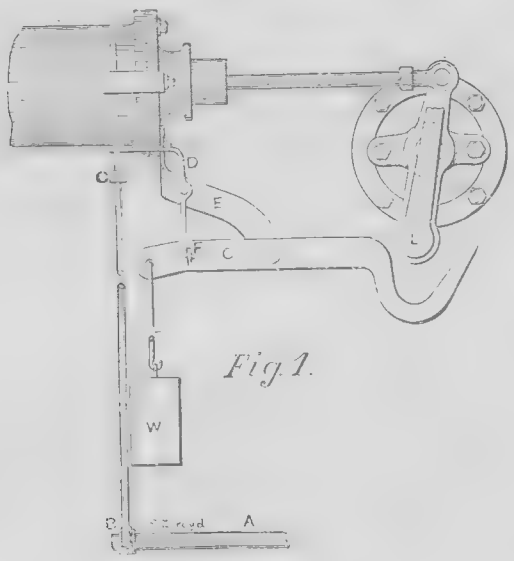


Fig. 1.

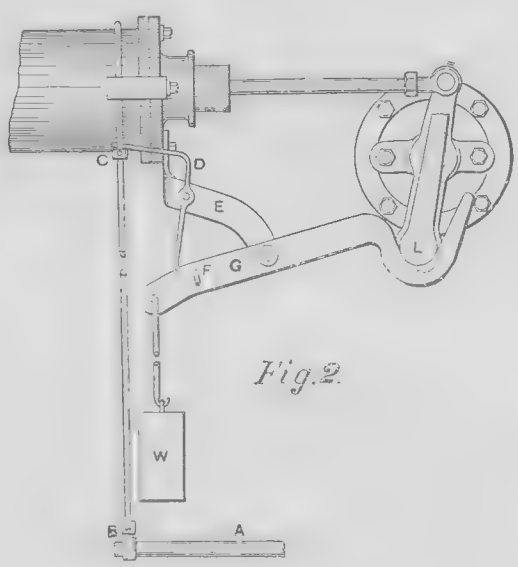


Fig. 2.

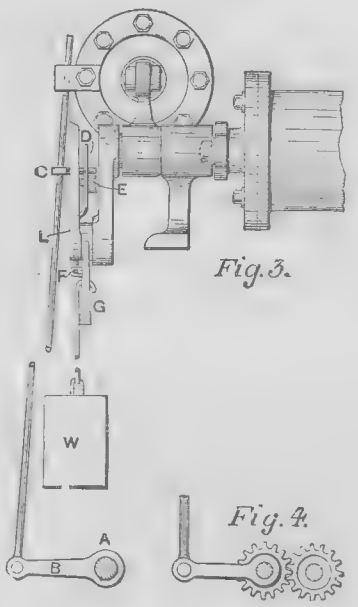


Fig. 3.

Fig. 4.

SAFETY ATTACHMENT FOR STEAM ENGINES.

A GRATE AREA of 3 to 1 of chimney area will permit of burning 15lb. of coal per sq. ft. of grate surface with a stack 80ft. high.

The Design and Construction of Stationary Engines.—XXXIV.

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Connecting Rods.—The connection between the crosshead and the crankpin, as its name implies, is made by means of the connecting rod, and through it the reciprocating motion of the piston rod is transformed into the rotary motion of the crankpin. The connecting rod is subjected to several kinds of stresses—viz., alternate compressive and tensile stresses, and also a cross-bending stress, due to its vertical oscillation. In engines of ordinary construction, the two former stresses need only be considered in determining the dimension of the rod, the least diameter found being sufficient for the tensile, and the greatest section found usually at the middle sufficient for the compressive. But with quick-running engines, such as those used for electric light and similar purposes, the cross-bending stresses may become very considerable, and should not be overlooked. The calculations required to determine these stresses are too complicated to be of much service in the drawing-office.

Grasshoff has shown that the greatest stress comes on the rod at about $_{10}$ths from the crankpin end, and this should be the position of greatest diameter. This is approximately obtained by tapering the rod with a straight taper from the crosshead end to the crankpin end. Sometimes the rod is tapered to the $_{10}$ths distance, and thence parallel to the crankpin end. The rods of fast-running engines are sometimes made of I-shaped section, or rectangular, the greatest depth being in the plane of rotation. This form is common in locomotive practice.

Owing to the obliquity of the connecting rod, the force transmitted through it is greater than that exerted on the piston rod, and the velocity of the piston varies with the position of the crank in the forward and backward strokes. With a very short connecting rod the motion of the engine may be rendered very irregular, and the pressure on the guides becomes excessive for satisfactory work.

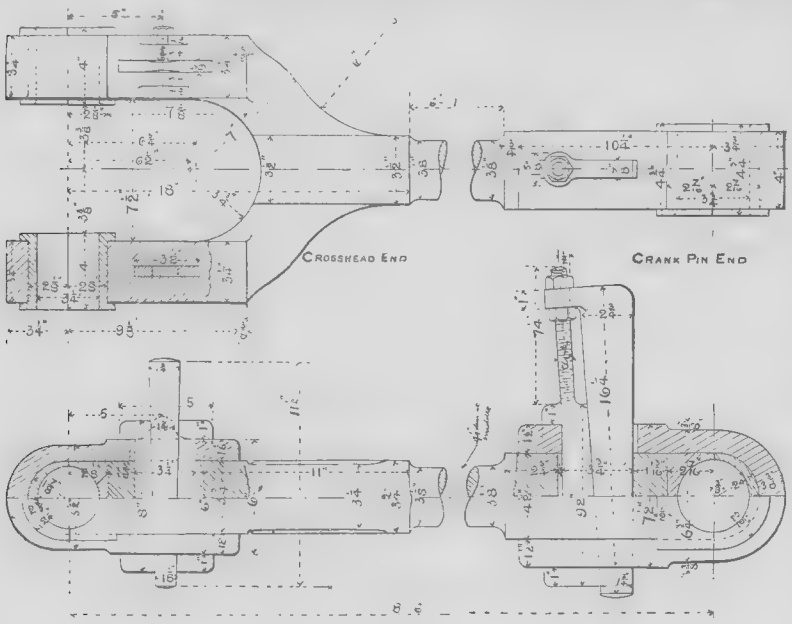


FIG. 164.

The length of the connecting rod varies from four to eight times the length of the crank.

Proportions of Connecting Rods.—The main proportions of connecting rods are most commonly deduced from empirical rules which have been found to give good results in practice. They are usually given in terms of the cylinder diameter, and are approximately sufficient within moderate limits.

The proportions which obtain in stationary practice are as follow:—The diameter at the middle varies from $\frac{1}{6}$th to $\frac{1}{4}$th of the cylinder diameter where the rods taper from the middle both ways. In short rods which taper from the crosshead to the crankpin end, the diameter at the former end may be 1 to 1·08 times the diameter of the piston rod, the taper being from $\frac{1}{8}$in. to $\frac{5}{10}$in. per foot. The area at the crankpin end is made larger, generally equal to the area of piston rod + $\frac{1}{4}$rd, or 1·08 times the area at the crosshead end. The diameter at the middle of double-tapered rods may be made equal to 1·054 area of crankpin.

Although these empirical formulæ give good results in ordinary cases, it is as well, in important cases, to apply some formula based on theoretical considerations to check the results obtained by such rules.

Applying the Gordon-Hodgkinson formula already used for calculating the piston rod, which assumes the connecting rod as a pillar rounded at the ends, we have, from Fig. 143, using the same notation as for piston rods and guides, R = the thrust on the connecting rod = L sec. ϕ $= \frac{nL}{\sqrt{n^2-1}}$. The maximum value of R occurs when θ, the angle which the crank makes with the axis of the piston rod, equals about 90°, if the load L is constant.

Assuming $\theta = 90°$; $L = \frac{\pi}{4} D^2 p_1$; and length of connecting rod $= l = n\frac{S_1}{2}$, adopting Rankine's formula, we have

$$R = \frac{fS}{1 \times 4a\frac{l^2}{d^2}}. \quad \text{Hence} \quad \frac{n\,L}{\sqrt{n^2-1}} = \frac{n\,\frac{\pi}{4} D^2 p_1 f^1}{\sqrt{n^2-1}} = \frac{36{,}000\,\frac{\pi}{4} d^2}{1 + \frac{4}{3000}\cdot\frac{l^2}{d^2}}$$

when f^1 = factor of safety. If d = diameter of connecting rod at crosshead end,

$$d = \frac{D}{5200}\sqrt{\frac{n f^1 p_1 (750 + r^2)}{\sqrt{n^2-1}}}.$$ The value of r varies from 8 to 16 in ordinary engines. The length l is generally determined from considerations of space, etc., and, as already stated, is usually from four to eight times the length of crank. If l is known, r may be determined approximately by considering the rod as a short pillar subject to compressive stress; or $\frac{\pi}{4} d^2 = S = \frac{L}{f}$ and solving for d.

By Weisbach's formula for diameter of connecting rod, we have $\frac{n\,L}{\sqrt{n^2-1}} = \left(\frac{\pi}{2}\right)^2$ E.I., and substituting as in the formula for piston rods, we have

$$d = 1{\cdot}273\ Dr\sqrt{\frac{p_1 f^1}{E\sqrt{n^2-1}}}$$

Diameter of a wrought-iron connecting rod

$$= \frac{Dr}{4150}\sqrt{\frac{n p_1 f^1}{\sqrt{n^2-1}}}$$

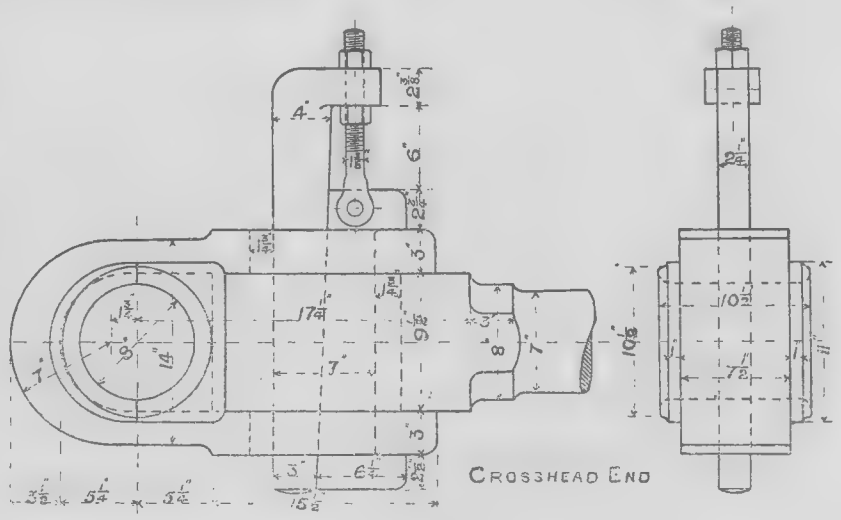


FIG. 165.

Diameter of a steel connecting rod

$$= \frac{Dr}{5090}\sqrt{\frac{n p_1 f^1}{\sqrt{n^2-1}}}.$$

These formulæ apply to a pillar which is subjected to a buckling stress only.

Connecting Rod Ends.—The forms of connecting rod ends used in stationary engine practice are very varied, each having supposed merits of their own, or adapted for particular purposes. The most common form of connecting rod end is probably what is known as the gib and cotter arrangement, as shown in Fig. 164. This particular end was designed for a horizontal engine having a cylinder 17in. diameter by 42in. stroke. It is formed with a single

end for the crankpin, and a double or forked end for the crosshead. The ends have loose straps enclosing the brass bush or step, and are kept in place by the gibs and cotters. As the brasses or steps wear, the cotter is driven or screwed down, bringing the back half of the brasses closer to the centre and taking up the slack. The main disadvantage of this arrangement is that in the drawing up of the strap the centres of the rod are shortened—*i.e.*, brought nearer together. The strap is usually made of wrought iron, sometimes, though not often, of cast steel, and the cotters should always be made of best mild steel, with rounded edges—never square. It will be seen that in this connecting rod the crosshead end is forked, forming two bearings for the pin, and that double gibs are used.

Fig. 165 shows a similar rod end for the crosshead end of a very large tandem mill engine having cylinders 30in. and 50in. respectively, stroke 6ft., running 52 revolutions per minute, boiler pressure 90lb., and indicating about 850H.P. The pin is 8in. diameter and 10½in. long, the piston rod being 7½in. diameter at front end, and of mild steel. The cotter is adjusted by means of a swing bolt, with lock nuts secured to the head of the gib.

(*To be continued.*)

The Compound Engine.*

THE aim to carry out and employ higher steam pressures, and the advisability of making the best possible and most economical use of the steam after its generation, gave rise to the present development and introduction of the compound engine. The compound engine is a combination of the high and low-pressure engines, the high-pressure engine operating with the high initial boiler pressure against a varying lower pressure exhausted to be made use of in a second or lower-pressure cylinder, generally and preferably connected to exhaust into the vacuum of a condenser. The high-pressure cylinder, therefore, only makes a partial use of the expansion abilities of the steam, reserving the balance for the low-pressure cylinder. The steam is generally exhausted from the high-pressure cylinder into an intermediate chamber or chest, where it is held ready for use and admission into the low-pressure cylinder. At times there are two such low-pressure cylinders, making the complete combination that is called a three-cylinder compound engine. Again, the steam after being used in the high-pressure cylinder is exhausted for use in a second cylinder, and again exhausted from the second cylinder into a third for use and expansion, finally reaching the condenser.

A standard ratio of areas or diameters of the cylinders in compound engine practice has not been and in all probability will never be settled upon, since surrounding conditions and the necessities of detail construction will necessarily have great influence in the work of design. The power to be developed governs the size of the low-pressure cylinder or cylinders, and space and opportunity control the size of the high-pressure cylinder. Naturally, while the mean and final pressures should be steady, for regular working operation and economy, the size of the high-pressure cylinder can be gauged by the allowed pressure upon the boiler and the possible room to be taken up. The exhaust of the high-pressure must be such as to furnish an easy supply of steam for required use in the low-pressure cylinder or cylinders. The lower the boiler steam pressure the larger the higher-pressure cylinder must necessarily be. As the initial or boiler-pressure increases, the ratio between the areas of cylinders will increase. The product of the areas of the cylinders by the mean effective steam pressure acting upon the pistons should be as near alike as possible, likewise the initial loads at steam admission should be as near regular and equal as possible.

For every increase in the initial pressures the expansion ratios will increase for equal powers and mean pressures. With increased initial pressures, however, increased initial strains will be developed upon the several parts. When the low-pressure cylinders are used their diameters are preferably made alike, and the high-pressure cylinder is made of sufficient size to supply both.

The local engine advantage gained by this division of the work of the steam consists in the reduced exposure of the steam to extreme temperatures at initial and exhaust ends of the stroke; and the pressure upon and the work of the pistons is more steady and regular, bringing the work of the metal nearer to its initial requirements than would result were the expansion and work accomplished within the single cylinder. In ordinary non-compound condensing engines the steam is compelled to meet a sudden change of temperature, since it enters the cylinder almost immediately after the closing of the exhaust to the condenser. The average exhaust and condenser temperatures are about 150° to 160° F., and the exhaust ports being closed and steam admission commenced, subjects the steam to a loss of heat in reheating the cylinder metal to steam-pressure temperature, changing some portion of the steam to water, effecting what is termed liquefaction. During its expansion and work the steam releases or loses some more of its heat, a portion of which is again taken up from the metal of the cylinder, causing a re-evaporation. Such reheating and re-evaporation, however, take place too late for engine usefulness, the condenser receiving it with the exhaust steam.

A portion of this heat trouble is overcome in the compound engine, since the variation in temperature occurring only in proportion to the variation in pressures, the cylinder metal takes up and gives out less. This is effected by the intermittent expansion brought about by the use of the several instead of the single cylinders.

To ascertain the increase in theoretical efficiency due to carrying increased steam pressures, the difference between the absolute temperatures of boiler steam and condenser vapour should be taken, and this divided by the absolute temperature of the boiler steam. Thus, assuming a temperature of, say, 150° F., or about 4lb. absolute pressure, the heat efficiency at 200lb. absolute steam pressure and 381·7° temperature will be equal to

$$\frac{(381\cdot7+460)-(150+460)}{(381\cdot7+460)}=\frac{841\cdot7-610}{841\cdot7}$$

$$=0\cdot2752, \text{ or } 27\cdot5 \text{ per cent.}$$

The heat efficiency for 300lb. absolute steam pressure, and a temperature of 417·5° F., and a condenser or exhaust temperature of 150°, will be equal to

$$\frac{(417\cdot5+460)-(150+460)}{417\cdot5+460}=0\cdot3048, \text{ or } 30\cdot48$$

per cent.; a gain of 30·48 – 27·52 = 2·96 per cent. For a steam pressure of 150lb. the efficiency is 25·45 per cent. These are comparative theoretical efficiencies; the actual efficiency will at all times be found much less, due in general to the condensation and interchange of temperatures within the cylinders while at work. The relative value of the several temperatures and pressures, however, remains the same. The gain in efficiency from 75lb., the original compound pressure, to 150lb. and to 200lb., the present pressures, may be rated between 22, 25 and 30 per cent., or from 14 to 37 per cent. increase in efficiency of the 150 to 200lb. over the 60lb. of original pressure.

There is an advantage due to the intermitting expansion of the steam in the two or more cylinder compound engines, and the reduced exposure to change of temperature. For instance, in a condensing engine, with the initial steam temperature at 307·50 for 75lb. absolute pressure, and the exhaust or condenser temperature at 150, the fall of temperature within the cylinder will be 307·5° – 150° = 157·5°. With these same temperatures in a compound, the fall of temperature, being made about equal in each of the high and low-pressure cylinders, will be 175·5 ÷ 2 = 78·7°. With the initial steam at a temperature of 366° for a pressure of 150lb. by gauge and 165lb. absolute, the change being equal in each cylinder, the fall in temperature will be 366 – 150 = 216°, or 108° for each of the high and low-pressure cylinders of a compound engine, and 216 ÷ 3 = 72° for each of the cylinders of a triple-expansion engine.

To effect a direct comparison of efficiencies in the simple, the compound and the triple-expansion engines, a single-cylinder engine is selected, operated under 150lb. steam pressure by gauge, and making 20 expansions for economical operation. The mean pressure in such case would be found by dividing 1 + hyp. log. of expansions by the number of expansions. (1 + hyp. log. 20) ÷ 20 = 1 + 2·9957 ÷ 20 = 3·9957 ÷ 20 = 0·199785, and 165lb. absolute initial pressure multiplied by 0·199785 gives a mean pressure of 32·961b. Deducting 4lb. for back pressure gives a mean effective pressure of 28·96lb. per square inch of piston, and this latter multiplied by the area of piston in square inches gives the total mean effective pressure.

With the same pressures and total expansion rate operating in two successive stages or on the compound principle, and assuming the high-pressure expansions at 5, and the low-pressure expansions at 4, the mean pressure in the high-pressure cylinder will be equal to 165 (1 + hyp. log. 5) ÷ 5 = 165 (2·6094) ÷ 5 = 165 × 0·52188 = 86·111b., and the final pressure will be 165 ÷ 5 = 33. With no loss of pressure between the two cylinders, the initial pressure of the large or low-pressure cylinder will be the same as the final pressure of the small or high-pressure cylinder, or 33lb. per square inch. Subtracting this 33lb. from the 86·11lb. gives 53·11lb. as the mean effective pressure. Working under 4 expansions, the mean steam pressure of the second cylinder will be equal to 33 (1 + hyp. log. 4) ÷ 4 = 33 (2·3863) ÷ 4 = 19·6871b., and 33 ÷ 4 = 8·25lb. final pressure. Deducting 4lb. from the 19·6871b. gives 15·6871b. per square inch as the mean effective pressure. Dividing 53·11lb., the higher mean effective pressure, by 15·6871b., the lower mean effective pressure, gives a cylinder area ratio of 1 to 3·385. Dividing 53·11 by the 3·385, to reduce it to the terms of the low-pressure cylinder, the sum of the mean pressures will be 31·374 against 28·96 mean pressure of the single cylinder engine, a possible gain of 31·374 – 28·96 = 2·4141b. per square inch mean effective pressure.

Again, with the same pressure and total expansion rate operating in three successive stages on the triple-expansion principle, and the cylinder having in turn 3⅓, 3 and 2 expansions, the mean pressure of the steam in the first cylinder will be equal to 165 (1 + hyp. log. 3·33) ÷ 3⅓ = 165 times 0·6609 = 109·051b. per square inch, and 165 ÷ 3⅓ = 49·5lb., the final pressure per square inch in the first cylinder. With no loss between the cylinders, the initial pressure of the second cylinder will be the same as the final pressure of the first cylinder, or 49·5lb. Deducting this 49·5lb. from the 109·5 gives the mean effective pressure of the first cylinder at 59·55lb.

With an initial pressure of 49·5lb. working under 3 expansions, the mean steam pressure of the second cylinder will be equal to 49·5 (1 + hyp. log. 3) ÷ 3 = 34·631b. The final pressure will be equal to 49·5 ÷ 3 = 16·5lb., and assuming this final for the initial pressure of the third cylinder for the third stage of expansion gives 34·63 – 16·5 = 18·131b. mean effective pressure for the second cylinder. For the third cylinder, the initial pressure being 16·5lb. per square inch working under two expansions, the mean pressure will be equal to 16·5 (1 + hyp. log. 2) ÷ 2 = 8·25 × 1·6931 = 13·9681b. per square inch. The final pressure will be 16·5 ÷ 2 = 8·25lb., and the condenser pressure at 4lb. absolute gives a mean effective pressure of 9·9681b. The ratio of the cylinder areas will be inversely as the mean effective pressures, or 1 to 3·3 and 5.

Putting the expansions the same in each cylinder of a triple-expansion engine, the cube root of 20 = 2·714 will represent the expansions for each. Then the hyp. log. for each rate will be 0·9984, and (1 + hyp. log. of 2·714) will equal 1·9984, and 1·9984 divided by 2·714 equals 0·736. Then 165 × 0·736 = 121·44lb. mean pressure for the first cylinder, 165 ÷ 2·714 = 60·8 initial pressure for second cylinder, and 60·8 × 0·736 = 44·751b. mean pressure; 60·8 ÷ 2·714 = 22·4lb. final pressure for the second cylinder, and the initial pressure for the third cylinder; 22·4 × 0·736 = 16·4864lb. mean pressure for the third cylinder, and 22·4 ÷ 2·714 = 8·26lb., the final pressure. The mean effective pressures, then, or the mean pressures less the back pressure of the three cylinders, are 121·44 – 60·8 = 60·64lb. for the first or high pressure, 44·75 – 22·4 = 22·35lb. for the second or intermediate cylinder, and 16·4864 – 4·00 = 12·4864lb. for the third or low-pressure cylinder. This last 4lb. is for the condenser back pressure. The theoretical areas, then, of the three cylinders will be as 1 to 2·71 and 4·71.

Arranging a table based upon the above data gives the following engine work:—

To develop the horse-power necessary to the differences arising between theoretical and actual mean pressures and resulting powers, an increase in the speed of piston may be provided for up to 20 to 25 per cent. To determine the maximum strains transmitted through each of the several cylinders, the product of the initial effective pressure by the area of piston, these loads are indicated on line 12 of the table. The initial effective pressures are indicated on line 4.

The advisability of adopting engines of the compound type depends upon the uses to which they are to be put. Where there is a steady and continued run of some hours their usefulness is clearly apparent. Where, however, starting and stopping is the prevailing feature of the engine use, their usefulness is at the lowest minimum. In starting up, live steam has to be admitted into the second and sometimes the third cylinder, and for this reason the evident economy in the use of the compound is overcome or greatly reduced by the loss in high-pressure steam used for such purposes, necessitating extra strength in the several operating parts to meet the requirements of initial high pressures.

	Single Cylinder.	Compound Cylinders.		Triple-expansion Cylinders			Lines.
Diameter of cylinder, inches..	60	33	61	28	46	61	1
Area ratios	—	1	3·416	1	2·70	4·746	2
Expansions	20	5	4	2·714	2·714	2·714	3
Initial steam pressures—absolute and effective—lb.....	165	165	33	165	60·8	22·4	4
Mean pressures, lb	32·96	86·11	19·68	121·44	44·75	16·49	5
Mean effective pressures, lb ..	28·96	53·11	15·68	60·64	22·35	12·49	6
Steam temperatures into cylinders	366°	366°	250°·9	366°	298°·5	234°·1	7
Steam temperatures out of the cylinders	181°·2	259° 9	184°·2	293°·5	234°·1	184°·2	8
Difference in temperatures....	181·8	106·1	175·7	72·5	59·4	49 9	9
Horse-power developed.....	800	399	403	269	269	264	10
Speed of piston	322	290	290	238	238	238	11
Total initial pressures on pistons, lb.	455,218	112,900	84,752	64,162	63,817	53,773	12

* By Wm. H. Weightman in the "American Machinist."

Practical Electrical Units and Electric Light Calculations.

I.

PROFESSOR W. E. AYRTON, in his inaugural address recently delivered before the Institution of Electrical Engineers, said that "students of electrical engineering should be well practised in calculating and designing, and should obtain sufficient acquaintance with methods of attacking new problems so as not to be daunted when they meet with them in after-life."

Now, the first requisite to an acquaintance with the calculations of electric-light problems is the proper understanding of the fixed standards and units, and the connection existing between them; and as electricity is pre-eminently a quantitative science, and, judging from the attention given to applied electricity, electrical engineering will evidently be the trade of the future, it is to be feared that many engineers engaged in electrical work have not paid sufficient attention to this part of the subject, but have very hazy notions respecting the connection between the ohm, ampère, volt, watt, etc. And it is hoped that by bringing before the readers of this journal a few notes on practical electrical units, increased attention will be given to the quantitative side of electrical work generally, though these papers are primarily intended for those who have not had the privilege of receiving instruction in electric-light calculations. Everyone must be conscious that the only plan of rapidly acquiring a thorough grasp of the principles of such calculations is to work through a large number of arithmetical examples, arranged so as to explain one or other principle. Our first business, then, will be to offer simple practical explanations of the standard units in the order in which experience meets with them, and the connections existing between them, and then to introduce examples for practice.

The Ampère.—Though we shall not concern ourselves about the nature of electricity, we shall occasionally make use of the analogy between electricity and fluids in order to simplify our explanations. Practically we have only to consider electricity in motion, and we generally speak of the electrical state of a conductor as if electricity were flowing or passing along the conductor just as water flows or passes along a pipe, and it will be well here to point out that in both cases the word current simply means "the rate of flow," and that it is not the current which passes through the conductor (wire or pipe), but electricity or water. Just as a certain quantity of water passes through a pipe in

a certain time under a constant pressure, so does a certain quantity of electricity flow through conductors at a certain rate per second; and as it is the number of gallons per second required for a certain purpose which has to be determined before using it, so it is equally important to know the rate of flow of electricity, or briefly the quantity passing per second, before applying electricity practically. And further, the unit of current strength (the ampère) can be defined without reference to any other electrical units, hence the suitability of studying first the various methods of determining a current's strength.

The existence of a current of electricity flowing through a conductor may be readily determined by the effects produced by and which always accompany the passage of a current. As is well known, a current of electricity possesses (1) magnetic, (2) chemical, and (3) heating properties. In other words, a current has the power (1) to create magnetic fields, deflect magnetic needles, and to magnetise iron; (2) to decompose compound liquids and to bring from them constituent elements; and (3) to raise the temperature of a conductor through which it flows. Experience alone decides which of these properties must be employed to ascertain readily and accurately the strength of a current. Whichever method is adopted, the effect produced must be directly proportional quantitatively to the strength of the current, and in no case is this so marked, and the determination so exact and easy, as in the electrolytic method—that is, by electrolysis. The laws of electrolysis were first stated by Faraday, and it is well known that when a compound liquid or an electrolyte, as it is called when a metallic salt is in solution, is placed in a cell, and we interpose this cell in the circuit of an electric current, the amount of chemical decomposition which takes place in unit time for unit strength of current is a fixed quantity, and is the same at all points of a circuit; and further, this fixed quantity is directly proportional to the strength of the current. We shall therefore define unit current as the current that deposits 0·00111815grm. of silver per second on a silver plate, a solution of $AgNO_3$ being employed as the electrolyte, or deposits 0·00032959grm. of copper per second on a copper plate, a solution of copper sulphate being employed as the electrolyte.

This definition will be the better understood by practically determining the value of an ampère from the details given below.

Electrolysis, briefly stated, is electric analysis, and the cell or bath arranged for electrolytic purposes is called a voltameter, indicating that such a cell may be used for measuring the strength of a current. Any cell the material of which is not affected by electricity may be used for electrolytic purposes, glass and glazed earthenware being particularly suitable. For reasons stated later on we recommend a copper voltameter. As already stated, the cell is interposed in the circuit of an electric current, and the current is led into a solution of copper sulphate by means of a copper plate, and conducted out again by another plate of the same material. After the current has been passed through the cell for a short time, one of the plates will be covered with a deposit of copper from the solution, and the other plate will be found to be less in weight by the amount of copper deposited on the first plate, the strength of the solution being maintained by the part dissolved. Thus, one of the plates is a gaining plate, and the other a losing plate. Technically, the gaining plate is known as the cathode (that plate which conducts the electricity out of the solution), and the losing plate the anode (the plate leading the current into the solution). To determine the amount deposited on the cathode it is, of course, necessary to carefully clean and accurately weigh that plate before and after the current has been passed, the difference in weight being the weight of copper deposited. From a large number of experiments the quantity of copper set free per second by 1 ampère has been found to be 0·00032959grm. This quantity, 0·00032959, is called the electro-chemical equivalent of copper, and similarly the quantity of any element deposited per second by unit current is the E.C.E. of that element. As the quantity deposited is proportional to the current, time and the electro-chemical equivalent, the equation $w = eCt$ (where w = weight in grammes, C = current in ampères, e = electro-chemical equivalent for the particular metal, and t = time in seconds) embodies all that is required for the determination of the current strength or the amount of metal deposited. Let us take a numerical example.

Example 1.—What is the strength of the current in ampères passed through a copper voltameter for 75 minutes, which deposits 59·3262grms. of copper, the current being supposed constant?

Now, $w = eCt$, and substituting the values given we get $59\ 3262 = (0{\cdot}00032959) \times C \times (75 \times 60)$.

$$\therefore C = \frac{59{\cdot}3262}{0{\cdot}00032959 \times 4500} = 40 \text{ ampères.}$$

Notes.—The following are the electro-chemical equivalents (E.C.E.) of the chief metals:—

The E.C.E of silver	...	= 0·00111815.
,, copper	...	0·00032959.
,, zinc	.....	= 0·0003392.
,, hydrogen		0·00001058.

From this table we notice that the best electrolytes to use for measuring a current's strength are silver, copper, or zinc salts, and as silver is deposited in the largest quantity, a silver salt is the best for accurate research. Silver, however, is somewhat difficult to manage, and for the following reason is not generally used. If the exact strength of current is not passed for the size of the plates, it is difficult to get a firm deposit, as the silver will be crystallised and non-adherent, causing a slight loss when finally washing the plates. The solution of silver nitrate should be pure, and contain about 10 per cent. of silver, and the plates should have an area of 400sq. centimetres per ampère. With a copper voltameter the plate should be rounded at the edges, and have an area of 2sq. in. for each ampère. The plate should be placed ½in. apart in a solution of copper sulphate, with a density less than 1·18. Thirty minutes is a suitable time for passing the current.

Belfast Mechanical and Engineering Association.

THIS association on Saturday, the 10th inst., made the last visit of the season (prior to opening their winter session) to the North of Ireland Paper Mills Company Limited, Ballyclare. A fair representation of the members were present. On arriving at the ancient inland village by the Northern Counties Railway, the members proceeded to the above works, where they were met by the manager (Mr. Foster), the engineer, and other officials. The boilers and steaming arrangements were first inspected. The four steel boilers lately put in were working at 120lb. pressure for driving the various engines which supplied the motive power, amounting in all to 150 I.H.P.

The members next witnessed the preparation of the grass, straw, rags, etc., in the early stages of the various processes through which they pass—cleaning, boiling, pulversing, washing, grinding, bleaching, etc.

The mill being in full work the visitors had a splendid opportunity of seeing the processes, both mechanical and chemical, which, together with the explanations by the various officials who conducted the members in groups through the very large and extensive works, added considerably to the pleasure of the visit. The large finishing machines, where the pulp in various tints is converted into a continuous sheet or roll of finished paper, are a marvel of excellence, being large machines performing such delicate mechanical operations as drawing, calendering, and rolling the finished paper. After a look in at the electric installation, fire-engine, etc., the visit was brought to a close by the vice-president thanking the manager and other officials for the kindness shown them during their very pleasant and instructive evening spent at the North of Ireland Paper Mills.

Metal Trade Memoranda.

Notices to terminate contracts with the tin house employés have been posted at the Swansea Tinplate Works.

The Normanby Iron Company intend starting another of its furnaces on hematite, having retired from the Cleveland trade for the present.

During the past week further cargoes of Spanish ore have been landed at Barrow by large steamers. This is causing much slackness in the local demand for iron ore.

The number of blast furnaces in operation in the United States at the commencement of July was 254, their aggregate weekly productive capacity being 169,151 tons.

The Teesside Iron and Engine Works Company Limited are making preparations to blow in two of their four blast furnaces at Middlesbrough, one of which it is intended to run on hematite and the other on Cleveland pig iron.

The proprietors of the Worcester and Upper Forest Tinplate and Steel Works, at Morriston, have issued notices intimating to the workpeople their intention to close the works.

The Dolcoath tin mine, Cornwall, is giving out some 600 tons of rich metal every month, and when the new stamps, now in course of erection, are in work, this quantity will be increased to 700 tons.

The Old Castle Tinplate Company, Llanelly, will shortly be in a position to supply its own tinplate bar, it being understood that plant for the manufacture of the material on the premises of the company is to be erected forthwith. The works are among the best-known and most thriving in the trade, and give employment to about 800 hands.

The measures taken by the Indian Government to develop the tin resources of Mergui are likely to lead to the formation of a strong syndicate. A Chinese millionaire from the Straits has applied for a grant of the whole stanniferous area comprising the Miliwun township. It is proposed to work the concession with Chinese miners from the Straits.

On the 5th inst., the makers of machine-made galvanised iron wire netting throughout England issued circulars announcing an amendment in the gross list prices. On and after that date all netting will be subject to one uniform gross discount to the trade, and will be invoiced at per roll of 50yds., and not at per yard as formerly. The new list shows a reduction on net prices of 5 to 6 per cent., and will avoid the complicated discounts to which the trade was previously subject. The Australian trade was particularly affected by the announcement.

The Metal Market.

PRICES CURRENT.

LONDON, September 12.

COPPER was steady and unchanged, and a good demand for prompt delivery soon resulted in a rise of 1s. 3d., which was steadily maintained to the close, although the demand became less active later in the day. Three months ranged from £44 12s. 6d. to £44 13s. 9d., and sharp cash sold at £44 3s. 9d. all day. Sales, 325 tons, exclusive of 150 tons sold on importers' account to arrive, guaranteed delivery in four months, the price of which did not transpire. Settlement price, £44 2s. 6d. English tough, £47 5s.; best selected, £48 5s.; strong sheets, £56.

TIN opened easier and lost 5s. under sales to realise, but the readiness with which subsequent offerings were taken imparted a better tone to the market, and after the official close values recovered somewhat, leaving off steady, but 2s. 6d. lower on the day. Sharp cash and September delivery made £91 15s to £92 17s. 6d., and £92 17s. 6d. was paid for one month's prompt. Sales, 60 tons. Settlement price, £92 15s. English ingots, £95 10s.

PIG IRON opened easy in sympathy with quotations from Glasgow, the best bid for Scotch being 2½d. below Friday's price, and the market afterwards further weakened, closing 2½d. to 3½d. down on the day. Transactions covered 1000 tons, three months fixed, which sold at 4s. 5d. and 4s. 4d. Middlesbrough and hematite were neglected, and closed 6d. lower. Settlement prices:—Scotch, 41s. 9d.; Middlesbrough, 40s 6d.; hematite, 50s. 6d.

TINPLATES quiet. J.C. cokes, f.o.b. London, 12s. 9d.; Liverpool, 12s. 3d.; Swansea, 11s. 9d. per box.

LEAD has ruled steady with sellers of Spanish at £10 2s. 6d.; English, £10 5s. to £10 7s. 6d.

SPELTER remains flat, and is again 2s. 6d. lower for September delivery at £20 2s. 6d., while September-October in seller's option is offered at £20. Specials (Silesian), ex ship, £21 sellers.

ZINC SHEETS.—Belgian quiet and 5s. lower; V.M.'s brands, ex ship, £23 5s.; f.o.b. Antwerp, £23 2s. 6d. Silesian dull and 2s. 6d. down, with ordinary at £22 17s. 6d. ex ship, and £22 7s. 6d. f.o.b. Stettin.

OFFICIAL CLOSING QUOTATIONS.

	£	s.	d.	£	s.	d.
COPPER—						
G. M. B.—Cash	44	3	9	—44	11	3
,, Three months	44	13	9	—45	1	3
English tough		—	—		—	
Best selected		—	—		—	
Strong sheets		—	—		—	
TIN—						
Fine foreign—Cash	92	15	0	—93	5	0
,, ,, Three months	93	0	0	—93	10	0
Australian—Cash	93	5	0	—93	15	0
PIG IRON—					s.	d
Scotch warrants Cash					41	9
,, One month					41	11½
Middlesbrough—Cash					40	6
,, One month					—	
Hematite—Cash					50	6
,, One month					—	

GLASGOW, Sept. 12.—The pig-iron market was flat to-day. About 10,000 tons changed hands, and the bulk was Scotch iron. There was a pressure of sales during the forenoon on the part of operators who supported the market last week, and the price sharply broke from 42s. to 41s. 8½d. At afternoon meeting, however, there was a slight rally, values recovering ½d., but the tone remained flat owing to the poor trade accounts. One lot Cleveland sold at 38s. 9d. all the year. The shipments of Scotch last week were 7367 tons, an increase of 435 tons on the corresponding week of last year, and making the increase for the year 30,023 tons.

QUOTATIONS.

	Highest.		Lowest.	
	s.	d.	s.	d.
Scotch warrants—Cash	42	0	41	8½
,, One month	41	11	41	10½
Middlesbrough—Cash	40	6	40	6
,, One month	—		—	
Hematite—Cash	50	4½	50	4½
,, One month	—		—	

Official Gazette.

Partnerships Dissolved.

MOODY and ANDREAE, Princes-mansions, Victoria-street, Westminster, electrical engineers

PULLAN, MANN, and GILL, Leeds, engineers and millwrights.

COCHRANE, COOPER, and SCHOLFIELD, Beverley, shipbuilders; as far as regards J. Scholfield.

J. PERKINS, SEN., W. H. PERKINS, G. PERKINS, and J. PERKINS, JUN., under the style of J. Perkins and Sons, Lichfield and Yoxall, iron-founders and agricultural implement makers; as far as regards G. Perkins.

W. HOLZAPFEL, M. HOLZAPFEL, and A. C. A. HOLZAPFEL, under the style of M. Holzapfel and Co., Newcastle-upon-Tyne, and Fenchurch-street, City, London, and Sebastopol, composition and varnish manufacturers and dealers.

J. JAMIESON and TAYLOR, Kingston-upon-Hull, consulting engineers.

S. MAY and J. W. C. PASS, under the style of the Hazelwell Rolling Mills, Stirchley, near Birmingham, metal rollers and dealers; as far as regards J. W. C. Pass.

THE BANKRUPTCY ACTS, 1883 AND 1890.

Receiving Orders.

ALEXANDER THUEY, Palace-chambers, Westminster, civil engineer.

GEORGE WOOD (trading as William Wood), Brighouse, and Clifton, near Brighouse, wire manufacturer.

Adjudications.

BENJAMIN DOBSON, Tebay, Westmorland, locomotive inspector.

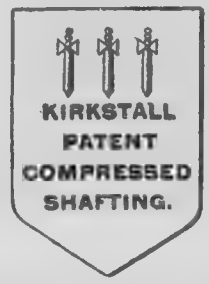
WILLIAM JOHN PORTER, Birmingham, tinplate worker.

GEORGE WOOD (trading as William Wood), Brighouse, and Clifton, near Brighouse, wire manufacturer.

Trade Marks.

The following is the Official List of Applications published from August 31 to September 7, for the Registration of Trade Marks, so far as relates to the Metal Trades.

CLASS 6.



"The essential particular of the Trade Mark is the combination of devices, and the applicants disclaim any right to the exclusive use of the added matter."

164,767. Shafting in iron and steel, being a finished part of machinery other than agricultural or horticultural machinery. THE KIRKSTALL FORGE COMPANY, The Kirkstall Forge, near Leeds; manufacturers.—12th May, 1892.

CLASS 6.

165,745. Machinery of all kinds and parts of machinery, except agricultural and horticultural machines included in Class 7. GEORGE SONNENTHAL, trading as Selig, Sonnenthal, and Co., 85, Queen Victoria-street, and 2 Lambeth-hill, London, E.C.; engineer and merchant.—2nd July, 1892.

New Companies.

ROOPER AND HARRIS LIMITED.—This company was registered on the 2nd inst., with a capital of £10,000, in £10 shares, to carry on the business of emery-wheel, grindstone, and machine makers, and manufacturers of other similar articles, and selling the same by public auction and private contract, whether by sale on commission or otherwise, and generally to carry on any trades or businesses auxiliary thereto.

ADOLPHE CROSBIE LIMITED.—This company was registered on the 3rd inst., with a capital of £15,000, in £5 shares, to adopt and carry into effect an agreement dated September 1, 1892, made between Mr. Adolphe Crosbie, of Wolverhampton, chemical merchant and manufacturer, of the one part; and Mr. William Henry Ingram (trustee of the company), of the other part; and to carry on the business heretofore carried on by the said Adolphe Crosbie, by the Red Oxide Company, and by Mr. William Tuckey, lately trading as the Cheshire Carrying Company, at Wolverhampton and elsewhere, and to carry on the businesses of manufacturers and merchants of acids, etc., and of paints, varnishes, oils, etc., and as mechanical engineers, machinists, galvanizers, japanners, enamellers, electro-platers, etc. The number of directors is not to be less than three nor more than seven; the first being Messrs. H. [illegible] S. H. Hewitt, E. T. Cresswell, and A. M. [illegible] qualification, £500; remuneration £[illegible] per annum, until the company in general meeting otherwise determine. Registered [illegible] Doubble, 5, Mitre-court, Fleet-street, [illegible] tered office, Walsall-street, Wolverhampton.

THE NEW WEIGHING MACHINE COMPANY LIMITED.—This company was registered on the 2nd inst., with a capital of £20,000, in £1 shares, to adopt and carry into effect an agreement dated August 30, 1892, made between Mr. Graydon Poore, of the one part, and Mr. Ernest Gates (trustee for the company) of the other part, to carry on in England and elsewhere the business of manufacturers, dealers in, and exhibitors of weighing machines of all kinds, and also the business of mechanical or electrical engineers, machinists, brass and iron founders, etc.

C. AND E. GRAY LIMITED.—This company was registered on the 1st inst., with a capital of £5000, in £5 shares, to acquire and take over, as a going concern, the business of brassfounders and cabinet brassfounders and metal workers carried on by Messrs. Charles and Edwin Gray, at Exeter-street, Birmingham, under the style of "C. and E. Gray," and to enter into and carry into effect an agreement to be made between Messrs. Charles Gray and Edwin Gray of the first part, Mr. Charles Fitchett Gray of the second part, Mr. Edwin Gray of the third part, and the company of the fourth part; and to carry on business in the United Kingdom and elsewhere as brassfounders and cabinet brassfounders, metal workers, and stampers and piercers, and also to carry on the business of general merchants and factors.

Miscellaneous Items.

A new arrangement for the detection of firedamp consists in pumping the air into a testing room and testing it with a Bunsen burner. If the air contains a dangerous quantity of firedamp it ignites, and, moving a valve, sounds a gong of warning.

Professor Silvanus Thompson has found that if a copper wire be covered electrically with an infinitely thin coating of zinc, until it looks like a zinc wire, and then be held in the air, the zinc will gradually disappear by sinking into the copper. The operation may be repeated several times. Although the wire then contains more metal than before, it is a worse conductor of electricity.

The death occurred early on the 5th inst., at his residence, Framwellgate, Durham, of Mr. Samuel Oldham, after a short illness. Mr. Oldham, who was the head of a large and well-known engineering firm, had lived in the city for thirty years. He sat for some years as a member of the Town Council and the local Board of Guardians, and was also a magistrate for the city.

The Greek Government has appointed a royal commission to periodically fix the sale price of emery. The industry in this valuable mineral is a State monopoly. Once almost the exclusive source of it, the island of Naxos, in the Greek archipelago, still supplies most of the emery used, though not a little of it has latterly been procured in the neighbourhood of Smyrna, in Asia Minor.

A new method is proposed by Major Heap, U.S.A., for lighting the Statue of Liberty in New York harbour, and consists in placing a 2000C.P. arc light under the torch with a reflector to throw the light upon the face of the statue, and two 100C.P. incandescent lamps in each of the 25 windows in the coronet. The present lights would be rearranged to throw beams of light.

It is said that the anhydrous ammonia motor invented some years ago is being experimentally tried on the railway from Manchester to Bolton. The estimated cost of running cars with it is a little less than 1½d. per mile. The apparatus consists of a small box in which are placed in proper proximity jars of water and of ammonia, so arranged as to accumulate and direct the energy generated as described. The result is a power sufficient to run a train of cars.

Copper and German-silver wire is now regularly made in large quantities as thin as 0·002 of an inch in diameter. It requires about ten miles of this wire to weigh one pound. It is made by drawing through drilled diamonds, and its chief employment is in the construction of telegraph receiving instruments for ocean cables, and in the making of testing galvanometers. Marvellously thin as this wire is, it is wound round with two layers of silk still finer than the wire.

To make a metal-cleaning soap, take 50grms. of cocoa-nut oil soap, cut up, and heat while adding as much water as will form the mixture into a thick pulpy mass. Then take 50grms. of English-red (known also as trip, brown-red, colcothar, and crocus Martis) ground with a little water, and 1½grm. of carbonate of ammonia; intimately mix these two substances, and add to the soap-pulp when cold while stirring. The compound thus produced is to be kept in stone jars, which should be covered with animal bladders or parchment paper.

In consequence of the fall in the price of silver, the Saxon Government has decided not to complete its work on the Rothschoenberger Stollen, which, if completed, would be the longest tunnel in the world. The tunnel was intended to drain the water from all the Freiberg silver mines and carry it to the Elbe. The main tunnel is 9 miles long, but its branches add 21 miles to its length, making the total extent almost 30 miles. The tunnel was begun at State expense in 1844, and after 33 years of continuous work it was opened in April, 1877.

The screw steamer "Tweed," launched recently by Messrs. David J. Dunlop and Co., Port-Glasgow, went on the 6th inst. for a trial trip in the Firth of Clyde. Her length between perpendiculars is 230ft.; breadth, moulded, 32ft.; depth, 16ft. 6in.; and tonnage, 1000 gross. The engines are of the triple-expansion type, with cylinders of 21½, 34, and 57in. diameter, by 42in. stroke; and with a pressure of 165lb., the I.H.P. is fully 1700. The trip was highly successful.

Trial was made in Chicago recently of a park wagon equipped with a small 3H.P. motor and a 24-cell storage battery. With five persons in the wagon, it left the barn of the American Battery Company, on Monroe-street, and travelled by way of Winchester-avenue to Jackson Boulevard, to La Salle-street, to the company's office at Monroe and La Salle-streets. The run was made in 22 minutes. After a few minutes another party made the return trip. It is calculated that the wagon can make ten miles an hour easily with the present motor, and can climb any hill in Chicago.

A model of ocean currents is to be exhibited at the World's Fair, Chicago. This model, which is a huge scientific tank, is made to represent the surface of the earth spread out on an area of about 30ft. square, the ocean and seas being shown by actual water. Small streams of water are ejected through pipes under the model so that the whole body of water moves exactly as the ocean currents move. The direction of the currents is shown distinctly by a white powder on the surface of the water. Near the model will be placed a large map giving the fullest details of the force, volume and direction of the various ocean currents.

The publisher of "The Mechanical World" will send a prepaid parcel of specimen copies to anyone, in any part of the world, who can distribute them advantageously amongst his engineering friends. Business card or bill-head should be enclosed as a guarantee of good faith, and number of copies stated.—Address: 391, Strand, London, or New Bridge-street, Strangeways, Manchester.

Prize Competition.

WE OFFER FOUR GUINEAS MONTHLY IN PRIZES FOR THE BEST ORIGINAL ARTICLES SENT IN ON ANY MECHANICAL, ENGINEERING OR ELECTRICAL SUBJECT.

IN ORDER THAT MANAGERS, DRAUGHTSMEN, FOREMEN, AND WORKMEN WHO HAVE HAD NO PRACTICE IN WRITING MAY NOT HESITATE TO SEND IN COMPETITIONS, IT IS TO BE UNDERSTOOD THAT ALL ARTICLES WILL BE FULLY EDITED AND CORRECTED, AND JUDGED OF SOLELY ON THEIR MERITS AS ORIGINAL CONTRIBUTIONS FROM A PRACTICAL POINT OF VIEW. THE OBJECT OF THE COMPETITION IS TO INDUCE PRACTICAL MEN TO COME FORWARD AND GIVE THE RESULTS OF THEIR EXPERIENCE.

CONDITIONS.

Competitions for our Monthly Prizes must be sent so as to arrive at the Manchester Offices of THE MECHANICAL WORLD, New Bridge-street, not later than the last Tuesday in each month. Articles arriving after that time will be placed in the following month's competition.

Written competitions must be on one side of the paper only. The contributions must be original, and relate to matters connected with Engineering, Mechanism or Electricity.

The Proprietors of THE MECHANICAL WORLD reserve the right to publish any competition, whether it gains a prize or not.

The competitions may be accompanied by diagrams, sketches or drawings.

Competitors should write the words "Prize Competition" on the envelopes.

Competitors are not confined to one, but may send any number of competitions.

The correct name and address of the sender *must* be distinctly written upon every competition, not necessarily for publication. Competitions can appear under a *nom de plume*.

☞ We cannot undertake to be responsible for any MSS. sent to us, though when stamps are enclosed for the purpose we will endeavour to return rejected contributions.

Queries.

☞ Readers are invited to avail themselves of this section for practical information on questions relating to Mechanical Engineering and the Scientific Industries.

☞ Queries and Replies should arrive at the Manchester Office not later than by the first post on the Tuesday preceding the date of publication.

PLUMBERS' UNION.—Required the address of the secretary of the Operative Plumbers' Union.—PLUMBER.

WHEEL MOULDING MACHINE.—Required the makers of a good wheel moulding machine for toothed wheels up to 6ft. diameter.—SMALL FOUNDER.

MAKERS OF STAMPED FORGINGS.—Required the names and addresses of firms making drop stamped joints and pins in small quantities.—J. T.

MAKERS OF SMALL CASTINGS.—Required the names and addresses of makers of light pattern worm wheels and small furnishing wheels.—H. M.

JAMES' PATENT SOUNDING MACHINE OR SUB MARINE SENTRY.—Can any reader oblige with particulars of this apparatus, or name of makers?—J. P.

HEATING RIVETS.—I should be glad to learn who was the patentee of the oil system for heating rivets on the Forth Bridge, and if it was successful in practice.—H. A.

MAKERS OF COMPRESSED PAPER.—Will any reader inform me of the address of a maker of compressed paper, such as is used for carriage wheels and the like?—T. D.

BOILER INSPECTORS.—Will any reader inform me as to the nature of examinations held for boiler inspectors, and if there are any books treating on same?—BOILERMAKER.

WOVEN BELTING.—Can anyone give me the recipe for or supply me with the proper paint for cotton belting? I can weave it right enough, but cannot get a satisfactory paint.—BARCELONA.

HARDENING CIRCULAR SAWS.—Can anyone tell me how to harden a circular saw 20in. diameter and ¼in. thick, to saw cast iron? I want to harden the cutting part only, and not the body of the saw.—J. WILSON.

HOT-AIR ENGINE.—Will some reader of THE MECHANICAL WORLD kindly oblige me with a section and principal dimensions of a ½H.P. single-acting hot-air engine of the Stirling cycle?—GEO. H. PERKINS, North Queensland.

PEAT COAL.—I shall be very pleased if any reader of your valuable paper can give me some information on the above subject. I am desirous of knowing what firms manufacture it; its properties as a heating agent; what is its heating power in comparison with ordinary good coal; would it be a cheap fuel for firing boilers?—J. W. GEMMEL.

VOSPER'S ENGINE.—I have a Vosper's patent high-speed four-cylinder engine, and should be glad to know what the cut-off in each cylinder should be; also the position of eccentric sheave at any given point? I believe the eccentric sheave has been altered before the engine came into my hands. A sketch would oblige.—R. F.

LOSSES IN STEEL FURNACES.—Could any reader kindly inform me the average per cent. of actual loss, and the average per cent. of skull, in the charge of a Siemens open-hearth steel furnace working charges of from 30 to 40 tons? And also the percentage of loss in heating slabs and ingots in the Siemens regenerative gas furnace?—J. R. R.

STEEL CASTINGS.—Will any correspondent enlighten me as to the method of casting buffer boxes for railway vehicles in steel. What would be the best kind of pattern to use—wood or cast iron,—and would it require to be in two halves with core box? I should like the address of a firm that would undertake the making of such. Can they be cast in the open sand?—ENGINEER.

BOAT PROPULSION.—If a boat floats down a river, will it be carried forward at the same speed as the stream is flowing? Or can it be proved that it will go slower than the stream? How much force in lb. will be required to propel a boat of a given weight against a stream or up a river flowing with a certain velocity, so that the boat shall move up the river with the same speed that the stream is flowing down?—HYDRA.

CAMS AND BOWLS.—(1.) When subject to little pressure, studs work in the cam race without any roller or bowl on them. At what amount of pressure ought a roller to be used on the stud to work in the race? and how is the pressure on the stud to be calculated for a cam to turn rotary motion into to-and-fro straight motion if the groove or race is 12in. diameter and moves a bar 4½in. in each direction? (2.) What is the pressure on a wiper cam to lift 2cwt. at 1¾in. from shaft? and also, what is the strain on the cam shaft, and how can I find it for other wipers? (3.) What is the pressure on the ball bearing in a ball mill, and how is it found? The mill is to grind 75lb. at a time, and the ball works in a hemispherical footstep bearing and at end of inclined spindle, the top end of which makes a circle of 1ft. diameter in turning. Weight on spindle about 1 ton.—OATS.

LOCOMOTIVE CONSTRUCTION.—Will any correspondent enlighten me as to the mode adopted in locomotive work in order to fix the position of the axles (horizontally) so that each axle may have a predetermined portion of the total weight resting upon it? Say:—

Load on leading axle	.....	0·32
" driving "	.....	0·48
" trailing "	.....	0·20
		1·00

Of course, I am aware there are certain circumstances—such as length of barrel, position of firebox, etc.—which in practice to a great extent influence this; but the point I wish clearing up is: Given the total weight, how are the positions of axles determined so that the prearranged weights rest on them? An answer would be of service to others as well as to—HILLSLAND.

Replies.

☞ Owing to the constant increase in our correspondence, we regret that we have no alternative but to announce that we cannot reply by post to Queries even when stamped envelopes are sent.

☞ Queries and Replies must in all cases be accompanied by the names and addresses of the writers, as no notice will be taken of anonymous communications.

READER.—We know of no such work.

H. B. AND T. J. W.—No address is given.

ENGINE.—See reply to "Engine" in our last issue, and to "Novice" in the issue for the 2nd inst.

CONSTANT READER.—Full description and details of the engine appeared in our issue for November 2, 1889.

T. B.—Messrs. Werner and Pfleiderer, 86, Upper Ground-street, will doubtless be able to supply you with machines for grinding cocoa nibs and splitting peas.

T. H. T.—We know of no book likely to exactly suit your wants. "First Principles of Mechanical Engineering," 3s. 6d., may help you. It may be had from our office.

PROGRESS.—You are mistaken in supposing that the prize competition has been discontinued. Of late very few of the contributions have possessed sufficient merit to warrant their publication. We do not think the times of starting at the different work, would be of very great interest, and the heads of engineering firms do not, as a rule, care to discuss their business methods. Certainly there is no book upon the subject.

ONE ANXIOUS TO KNOW.—It is impossible to give you the number of patents which have been taken out for automatic fire extinguishers. Your best plan will be to study the published specifications of patents at the public library in your town. There is no work on the subject.

TINPLATE MILL ROLLS.—Can any reader give the proper mixture for brasses for the bearings of these rolls?—TINPLATE.—*A.*—Mr. C. Polyblank of Wind-street, Swansea, is supplying the very article largely for tinplate rolls, and will assist you upon application.

EXPANDING RIMERS.—Will "W. A. S. C." kindly give further information *re* expanding rimers as promised, if possible?—J. W. C.—*A.*—I have since been waiting the convenience of the patentee, who was not quite ready for giving publicity to the particulars in question. They are now promised for an early publication in this journal.—W. A. S. C.

Latest Inventions.

APPLICATIONS FOR LETTERS PATENT.

When Patents have been "communicated," the name of the communicating party is printed in italics.

Where complete specification accompanies application, an asterisk is suffixed.

27th August, 1892.

15,444 MANUFACTURE of STEEL. H H Lake. (*G F Simonds*, United States.)

15,445 MANUFACTURE of SPHERICAL ROLLERS or BALLS. H H Lake. (*G F Simonds*, United States.)

29th August, 1892.

15,458 SELF-ACTING MOTOR. J Partington.

15,469 SIGNALLING APPARATUS for TELEPHONES.* G E Heyl.

15,472 NON-OVERHAULING HOIST. G Pinnington.

15,476 SURVEYING INSTRUMENTS. J W Shepard.*

15,477 MELTING METALS by ELECTRICITY.* A F W Kreinsen.

15,485 TOOL HOLDERS of STONE-DRESSING MACHINES. F Trier.

15,489 PYROMETER. H P J Negretti and M W Zambra.

15,492 LUBRICATION of PARTS of MACHINERY with the AID of ELECTRICITY. H H Lake. (*J F A Höper* and *A Jacobson*, Germany.)

15,495 GUILLOTINE. R C Annand.

15,497 COMPOUND STEAM PUMPS. J Evans and R W Deans.

15,501 TOOL HOLDERS.* G Armstrong and E Vasey.

15,508 VALVE MOTIONS for STEAM ENGINES. H W Widmark.

30th August, 1892.

15,514 FURNACES.* J Sargent.

15,520 VENTILATING MACHINE. J Evans and E Breadner.

15,538 DRAWING COMPASSES. A and L Myers.

15,542 DEVICES for CONSUMING SMOKE in FURNACES.* T Langer.

15,549 PETROLEUM or LIQUID HYDROCARBON ENGINES. J Roots.

15,551 METALLIC TUBES. C L Stiff.

15,556 MACHINE for MAKING WELDLESS CHAIN. J F Goldingg.

15,560 COMPOUND ENGINES.* H H Lake. (*N Gamble*, United States.)

15,582 PREVENTING the CORROSION of the PROPELLER SHAFTS of MARINE ENGINES*. E Jordan.

15,584 EXTRACTION of METALS from their ORES.* J W Chenhall.

15,591 ELECTRIC ARC LAMPS. J C Wüst.

31st August, 1892.

15,597 FURNACE FIRE GRATES. P. Jack.

15,600 METALLIC PACKINGS. S A Ward.

15,607 ROTARY ENGINES or ROTARY MOTORS OPERATED by FLUID PRESSURE. J Dawson.

15,615 TUBULAR STEAM BOILERS. J Lutz.

15,620 PUMPING ENGINE.* H Davey.

15,633 COMBINED PRESSURE TANK, ELEVATOR, and FIRE SERVICE SYSTEMS. R H Thorpe and American Elevator Co.

15,635 TUBE EXPANDERS. J McKay.

15,637 DOUBLE or MULTIPLE CYLINDER ENGINES.* A Collmann.

1st September, 1892.

15,665 ELIMINATING the CROSS MAGNETISM in the ARMATURES of CONTINUOUS CURRENT DYNAMO ELECTRIC GENERATORS and MOTORS. J Dick and W Scott.

15,670 LATHES. The Palatine Engineering Company Limited and R Blakiston.

15,674 PLURAL SCREW ENGINES. M Paul, jun.

15,675 PRODUCTION of FORCED DRAUGHT in the FURNACES of STEAM BOILERS. A H Murray and J Patterson.

15,677 ARRANGEMENTS for GOVERNING STEAM TURBINES. C A Parsons.

15,680 MOVING and TURNING OVER INGOTS, BLOOMS, and BARS at ROLLING MILLS. B H Wright.

15,689 RELAYS for ELECTRIC TELEGRAPHS. C R J Willot.

15,690 OVERHEAD TROLLEY for ELECTRIC RAILWAYS.* B and A Kochs.

15,691 ELECTRIC AIR SHIPS.* C Drill.

15,700 RAILWAY SIGNALLING APPARATUS. W R Sykes.

15,701 RAILWAY SIGNALLING APPARATUS. W R Sykes.

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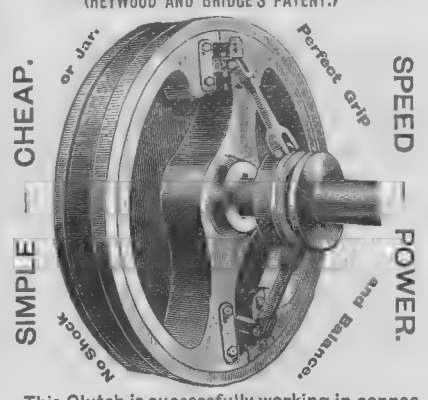

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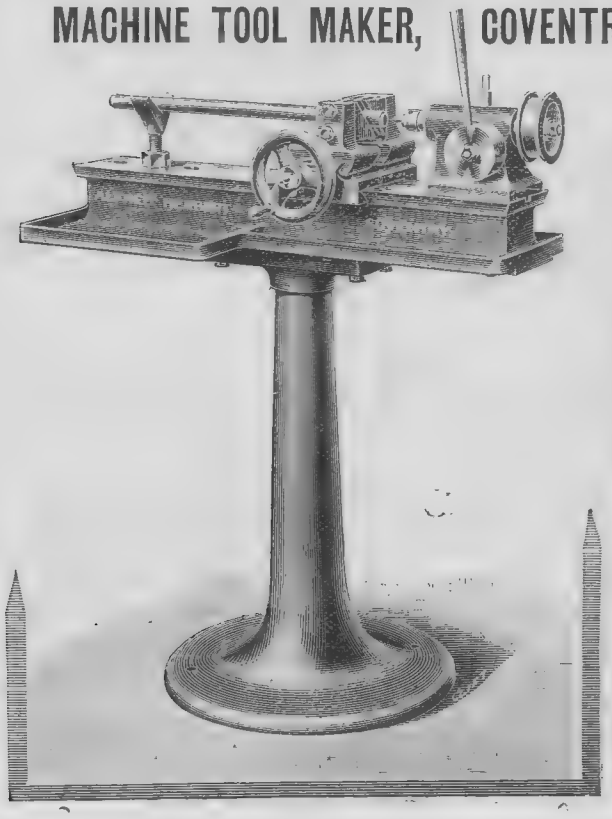

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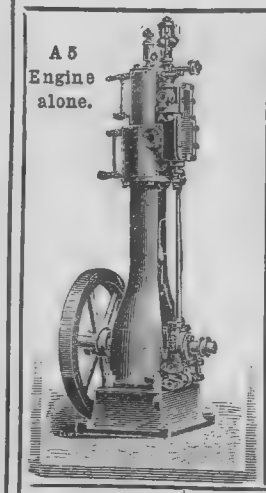

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☞ THE MECHANICAL WORLD *is published every Friday at 391, Strand, London, and at New Bridge Street, Manchester. It is particularly requested that business communications from the Provinces be addressed to the Offices at New Bridge Street, Manchester, and London communications to 391, Strand. Letters referring to Editorial matters should in every instance be sent to the Manchester Office.*

FRIDAY, SEPTEMBER 23RD, 1892.

Inter-communication in Railway Trains.

MUCH attention has of late been given to the problem of providing a more efficient means of intercommunication in railway trains than is afforded by the present old-fashioned cord connection, which has long been recognised as entirely inadequate to the requirements of modern railway traffic. Mr. Harry Pollitt, of the Manchester, Sheffield and Lincolnshire Railway, has devoted much time to the examination of the various appliances used upon British and Colonial railways, and in a paper read before the International Congress on Railways, at St. Petersburg, he has critically examined the claims made on behalf of the several systems. To the various electrical systems he raises the objection that they are delicate and uncertain. The original electrical system of Walker, as modified by Leonard, has been in use on the South-Eastern Railway for over a quarter of a century, and Mr. Pollitt admits that it has worked fairly well; but, in view of the delicate character of the apparatus, with its numerous contacts and surfaces so seldom used, the difficult question of effective coupling, the exposure of the train to dust, rough treatment, weather influences, etc., the liability of the train to be divided or added to *en route*, he is unable to recommend it for general acceptance. His alternative is a pneumatic system, the working of which he explains in considerable detail. The central idea of this system is the application of the means already provided in connection with the continuous brake to effect the desired communication, each coach being fitted with a small air-admission valve which is connected with the continuous brake pipe. When this valve is opened it admits sufficient air to the brake pipe to reduce the vacuum from 20in. to 10in. of mercury. This reduction of vacuum is indicated by the gauges placed on the engine and in each van, and is equivalent to the application of the brake throughout the train to the extent of about half its power. When the driver finds that a communication has been made he can stop at once, or if the train be in a tunnel or in some other inconvenient or perhaps dangerous place, he can, by applying his brake ejector, exhaust from the brake pipe the same amount of air as is admitted through the communication valve, and thus practically release the brake and run on to a place of safety. The same act which opens the communication valve throws out a signal on each side of the train, so that even before a stoppage has been effected the guard can identify the coach from which the alarm was given. The position of the handle of the communicator indicates the particular compartment.

American Tinplate Machinery.

THAT American tinplate manufacturers are determined to firmly establish the industry in the States, is by this time evident to all who are in the least interested in the matter. One of the pioneer companies in the movement is the American Tinplate Machine and Manufacturing Company, Philadelphia, who have recently perfected a machine which turns out a plate in a long roll. The machine is 80ft. long and 4ft. wide. Black steel sheets, 10ft. long and 20in. wide, are taken from a pickle which removes all rust, and fed into one end of the machine, passing through the different processes of cleaning, dipping, and soldering together, coming out finally at the other end a continuous roll of plate. The sheets are obtained from Pittsburg, being made specially for the machine. American sheets have to be used on account of the unusual length necessary. After being fed into the machine, the sheets are carried along by rolls, passing first under two brushes, which by the use of sand scour the top of the sheets. Further on two more brushes scour the under side of the sheets. They then pass between sprays of water, which give a final cleaning. Three steam or felt rolls surrounded by steam jackets next come in contact with the plates, bringing them to any degree of moisture desired, and preparing them for coating. Before passing into the flux, the ends of the sheets come under the action of an ingenious device which makes compact seams. From this point the sheet becomes continuous, passing, by means of a series of rolls, through a flux box containing oil flux, and then through the metal in the pot, which is covered with palm oil. The seams are soldered by the metal, the two operations being performed at once. After leaving the pot, the plates pass between rolls, which are adjustable, partly regulating the thickness of the coating. No boxes will be used, the intention being to sell the tinplates in rolls of suitable length. Two men are required to work the machine proper, and the complement is six men, one of them a skilled mechanic. The minimum capacity of the machine is stated to be 100 boxes in a day of ten hours.

The Ventilation of Underground Conduits.

WHILST the metropolis has been practically free from gas explosions due to the escape of gas from gas mains in close proximity to electric-light mains or cables, several explosions of gas have occurred in Paris. These accidents have, rightly or wrongly, been attributed to the gas coming into contact with a cable having its insulation damaged, or where sparking has taken place through a short circuit being formed between bare conductors. However this may be, the Paris municipality, which supplies one sector or district of that city with electric light from the Halles central station, has adopted a method of ventilating its conduits so as to reduce to a minimum the risk of an explosion which might occur under similar circumstances to those above stated. In some cases in Paris the gas, water, compressed-air, telegraph, and electric-light mains are laid in the sewers, whilst in other instances they are distinct. We believe the municipal electric mains are in the latter category. The ventilator is portable, is carried on two wheels, and is of the centrifugal type. It is drawn and operated by one man. When it is desired to use the ventilator, the cover of the manhole is removed, and by raising the handle used to haul the apparatus, the ventilator is lowered and fits exactly in the top of the manhole. The apparatus will extract the air from the conduit for a length of about 650yds., but in practice the municipality depends upon only 110yds. being treated. The results have been very satisfactory, and although the air extracted at first emitted an offensive odour, an accumulation of coal gas was not discovered. In one case, however, owing to a gas explosion which had nothing to do with the town electric mains, a quantity of gas collected in a manhole, and in a certain length of conduit; but the application of the portable ventilator for a short period soon removed the gas. The success of the apparatus has been such that one of the electric-light companies is about to follow the example of the municipality and adopt the portable ventilator. *Verbum sat sapienti.*

Storage-battery Traction Progress.

THE world over, or, perhaps more correctly, wherever storage-battery traction has been experimented with for street lines, this method has, we believe, without exception always proved a fiasco from a commercial point of view. We do not now propose to enter into the reasons for this state of affairs, as they have from time to time been set forth in these columns, but it is noteworthy that previous failures do not seem to deter promoters and others interested from making further attempts to solve the problem. Even in Paris, where a few experimental cars have been put into service and subsequently withdrawn, another endeavour is about to be made at the initiative of M. Broca, director of the Compagnie des Tramways Nord. In this case it is intended to work two lines of a total length of eleven miles with accumulator cars, sixteen of which will be set in operation. Some of the cars are said to be already built, and if all of them are placed on the lines the experiment will be the largest yet made with this system. The cars are capable of accommodating 52 persons, and the batteries are arranged under the seats, after the style adopted in this country, and different from that previously introduced in France. Laurent-Cély accumulators will be used, each car being provided with two motors, one on each axle. The horse cars on the Paris tramways travel 62 miles daily, but the electric cars are to make about 80 miles per day. Pending the starting of the installation, it may be well to draw attention to an extraordinary statement made in the columns of an American paper, the title of which, for its own reputation, we refrain from giving. We are told that in the space of about four months a storage-battery system will be brought out which will, from the practical results now obtained, "result in placing the storage battery first in consideration of future electric questions, both as to initial cost of plant and economical use for power." Details are of course withheld, but the paper in question stakes its reputation that "within one year from the time the new system comes on to the market, the trolley for street-railroad propulsion will be a thing of the past, save only in places where constructors of that system put out their own money to continue it; for guaranteed results will talk to all independent operators." We have already heard of guaranteed results in this country, and particularly as regards the batteries which form the principal defect of the self-contained system; but so far such warranted proposals have not conduced to success. The cost of working accumulator cars, from the experience gained here, is not less than 6d. per car mile, and has ranged up to as much as 9·90d. at Birmingham, whilst on the Soldiers' Home Railroad at Washington, U.S., the cost is given at 4½d. per car mile. This figure is, we think, deceptive, since it has been ascertained that the line had only been in operation for five months, and no renewals had been made, although allowance for them is reported to have been made. On the other hand, with the overhead trolley system, the cost per car mile is roughly from 3d. to 3½d. Yet we are to have a new system which is to beat the trolley—or, rather, "lick creation." Tall talk may do in the United States, and the above-quoted statement can only be characterised as such and entirely misleading. Cars weighing something like 10 to 12 tons when full, with their attendant defects and with unascertainable data of a reliable nature of their working cost—at least only after say two or three years' service (and where are there cars with published results after such a period of service?)—cannot, we venture to think, be expected to seriously compete with trolley cars weighing, say, six tons at the most. However, there is room for improvement in storage-battery traction; such betterment will, no doubt, be made at some future time, but it will not effect a revolution of the character mentioned in the bombastic statement already quoted. There is certainly a future for the self-contained system; we are waiting for it; but it cannot very well supersede the trolley method, except in large cities and for æsthetic and not purely for economical purposes.

Errors in the Design of Pulleys and Shafting.*

IN the following paper I propose to notice some of the causes of waste in power transmission by pulleys and leather belting, leaving the amount of loss to be determined in each special case.

A line of shafting is subjected to two strains—viz., a transverse strain, due to the various forces applied perpendicularly to it between the points of support and the torsional strain, due to the forces turning the shaft by means of the driving pulley.

The transverse strain, due to the weight of the shaft itself and of the pulleys it carries, is increased by the tension of a belt running downward from the shaft and decreased by that of a belt running upward. The resultant transverse strain, due to a combination of the foregoing with those due to horizontal or inclined belts, is to be found by the parallelogram of forces.

It will be seen at a glance that the less transverse strain there is the easier our shaft will turn. To keep the flexure of the shaft down to the minimum it is best to have the hangers so spaced that they will come as near as possible to the pulleys, especially the larger ones; and for the same reason belts pulling off opposite sides of a shaft should be as near as possible to each other. Main driving pulleys should always have a hanger on each side. This practically prevents all flexure of the shaft—a flexure which, when considerable, very quickly tells on the life of a plant.

The torsional or twisting strain on a shaft is greatest near the main driver, and decreases as power is taken off the shaft, becoming zero (except for friction at the bearing) at the end of the shaft. When the shaft is very long and light, the torsional strain is apt to produce a very undesirable jerky motion at its extreme end. This can be reduced by placing the main driver in the centre of the line, thus reducing the strain put upon the shaft. This arrangement allows the use of lighter shafts with a reduction in the first cost.

All possible care should be taken to have the bearings rigid, so that they shall hold the shaft firmly in place. At the same time they must not bind the shaft.

In a small mill in one of our Southern States, where I was at one time engaged, there was a very marked and expensive case of too tight bearings. On taking charge I found that while the boilers were doing exceptionally well, and while the indicator showed the engine to be working to perfection and developing nearly 125H.P., there was always a scarcity of steam. I at once ordered an examination, with the result that all bearings in the place, from the head of the main shaft to the smallest journal on the ore concentrator, were found to be so hot that water would boil when

* Paper read before the Engineers' Club of Philadelphia, by Allan N. Lukens.

thrown on them. After going over these, putting in liners, repouring, etc., where necessary, until everything worked smoothly, the engine was found to be exerting only 115H.P., showing an enormous, almost preposterous, loss through this cause alone.

The fuel used was green pine wood, and before the overhauling five and a half cords were required for a ten-hour day. After the readjustment the consumption of fuel fell to five cords per day.

Shafting is often very greatly handicapped by the faulty application of the pulleys and belts. The most serious error made in this connection is that of running unreasonably tight belts. It is amazing how much power is wasted in this way, to say nothing of the trouble of broken pulleys, hot boxes, etc. The enormous and absolutely useless pressure thus put upon the pulleys must in time break them, besides wearing out the system of shafting and bearings. If manufacturers realised what these ridiculously tight belts cost them in a year, they would give vent to some very strong and expressive language. It has been calculated by several eminent engineers that the loss of power, from friction alone, in some of the best equipped mills in the country, is from 22 to as high as 39 per cent.

It is unreasonable to suppose that the minimum friction would consume this amount of power, and no other cause is so potent in increasing friction as undue tightness of belts, which, when they number by hundreds in a mill, easily account for the great loss of power referred to.

Estimating a horse-power as requiring a consumption of 40lb. of coal per day of ten hours, and granting that 15 per cent. is a reasonable allowance for loss of power through unavoidable friction, and taking the actual loss of power at 22 per cent. (the lowest of the figures given), we have a balance of 7 per cent. as the actual loss. This would be 2·8lb. of coal per horse-power per day.

The point next in importance to the tension of the belts is the arrangement of the pulleys. These should be as large as is consistent with a proper regard for symmetry and proportion; for the larger the diameter of a pulley the less the pull necessary to transmit a given amount of power.

The use of too small pulleys, by decreasing the liability to slipping of the belt, is often responsible for the employment of excessive tension in the latter. The following case in point came under my notice:—A few feet from the end of a line of shafting, and near the end hanger, was an 18in. by 6in. pulley driving a line of countershafting with a duplicate pulley. Noticing an odour of hot oil about the mill, I made an examination, and found that it came from the end hanger referred to, which was too hot to bear one's hand on. The engine was shut down, and a thorough inspection ordered, which brought word to the office that the shaft had worn through the babbitt in the box, and was running on the cast iron. As this was not a very satisfactory explanation of the trouble, I investigated further, and at once saw the real cause. The belt had been slipping badly, and had been taken up. Still it slipped, so another piece was cut out, until the tension had caused the shaft to cut through the babbitt, and also pulled the hangers on both shafts considerably out of line. On questioning the man in charge it was found that this belt had always slipped ever since it was put in, being thus a continual source of trouble, besides wearing out the belt very quickly. A new belt had been put on only three months before and was now entirely useless. The only spare pulleys available were two of 34in. diameter by 4in. face—that is, nearly twice the diameter of the former one and 2in. face less. These two pulleys were put on and an old 4in. belt used, having the proper tension. This has been doing the work with entire satisfaction ever since, now nearly two years, showing conclusively that the whole trouble came from the use of a small pulley which required an undue tightening of the belt in order to avoid slipping. The distance between centres of these shafts was 22ft.

The opposite fault, that of too slack belts, is also to be avoided, particularly in long spans, as it will cause flapping and swaying of the belt. A very marked case of this kind came to the writer's notice in this way: A neighbouring factory had recently put in a new belt on a span of some 40 or 50ft. The belt stretched so as to sag nearly 16in., and the slack side swayed laterally with an even regular swing, corresponding with the vibrating length of the building, and imparting its motion to it, so that the whole system of timbers swayed in unison. This would have soon loosened every joint and nail in the building had it been allowed to go on. The remedy which I prescribed was to take up the belt until it sagged only 6in., and then to support both top and bottom sides of the belt with an idler.

To sum up the evil of errors in the design of systems of shafting, we notice, first, errors in the alignment of the shafting and in the spacing of hangers and pulleys; and second, errors in the adjustment of the bearings, in the size of the pulleys and in the tension of the belts. Lubrication I will leave for others to discuss. All these errors add to the useless expenditure of power, and consume time and labour in keeping things in good order.

The Design and Construction of Stationary Engines.—XXXV.

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FIG. 166 shows a rod end in which the strap is secured together and prevented from opening out by two bolts, in place of the usual gib. A broad cotter placed between the bolts takes up the wear, and is secured in place by a small steel set screw at the side. The brasses in this instance are lined with white metal, run into dovetailed grooves cut in the brass shell.

Fig. 167 is a similar end, with the two bolts placed behind the cotter.

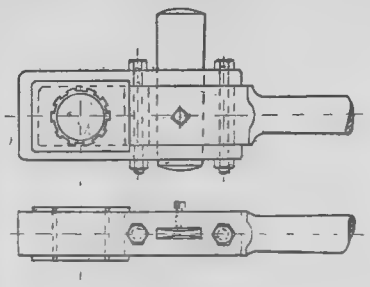


FIG. 166.

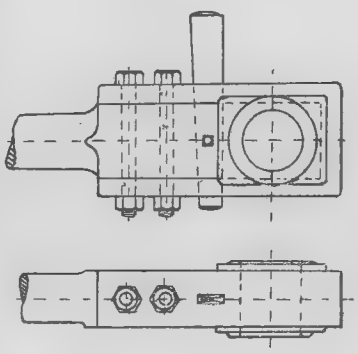
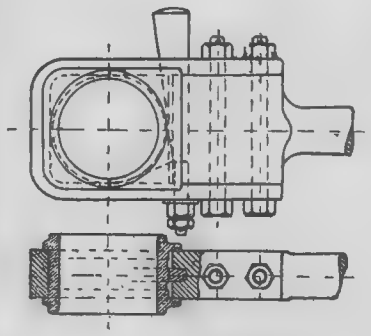


FIG. 167.



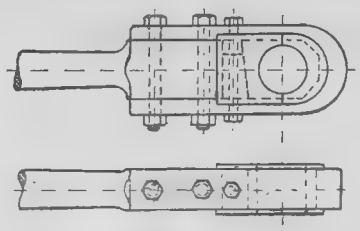


FIG. 169.

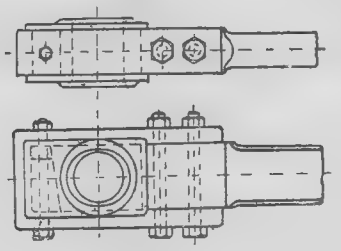


FIG. 170.

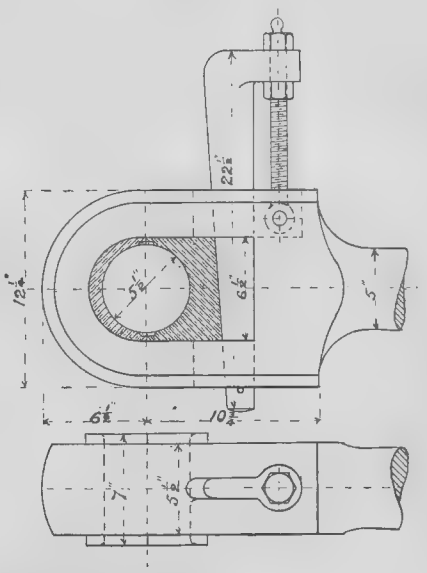


FIG. 168.—DESIGN, ETC., OF STATIONARY ENGINES.—FIG. 171.

Fig. 168 shows yet another modification. The bolts are placed behind the cotter, which has a fairly quick taper, the back of the brass being thickened up and tapered to suit. The cotter is adjusted and locked by means of the nuts as shown.

Fig. 167 is a similar end, with the two bolts behind the cotter.

Fig. 168 shows another form, the cotter being drawn by a nut and fixed by a lock nut. Some makers, while using the loose strap, provide for adjustment by means of a sliding block placed behind the back half-brass, actuated by a screwed bolt passing through the sliding block, which raises the block up or down as desired. Such a rod end is shown in Figs. 169 and 170. In the one case, the sliding block is placed behind the pin, and in the other in front. Many makers prefer to make the crank-pin end of the rod solid, the opening for the brasses being machined out to suit, as in Fig. 171. The back half-brass, it will be seen, is made considerably thicker than usual to withstand the pressure of the cotter, which is secured and adjusted by the screwed eyebolt, let into the body of rod end.

(*To be continued.*)

Society of Engineers.

THE next ordinary meeting of this society will be held at the Town Hall, Westminster, on Monday, the 3rd October, when a paper will be read on "The Cleansing and Ventilation of Pipe Sewers," by Mr. B. A. Miller, of which the following is a synopsis:—The combined system of sewering; faulty house connections; the partial separate system; advantages gained; sewer flushing by penstocks; automatic flushing; Doulton's, Field's, Palmer's, and Adam's automatic flushing syphons; description of action and comparison; Rogers Field's improved syphon; flushing chambers; water supply and meters; sewer air ventilation by open gratings; charcoal trays; Latham's spiral ventilator; chimney shafts; sewer gas destructors; ventilation by iron shafts; experiments on ventilating shafts at Beckenham; general conclusions.

A Large Engine Contract.

THE Edward P. Allis Company, of Milwaukee, have engaged to construct six 2000H.P. and eight 1000H.P. engines, at a total cost of £100,000, for the Brooklyn (N.Y.) Electric Railway Company. The diameters of the cylinders of the compound 2000H.P. engines are to be 32in. and 62in., and the stroke 60in. The 1000H.P. engines are to have cylinders whose diameters will be 26in. and 48in., and the stroke 48in. The steam-pressure is to be 140lb. to the square inch. There will be one marked peculiarity in the engines: the armatures of the electrical generator, which are to take the place of fly-wheels, will be the largest ever constructed; they are to be about 18ft. in diameter. The great size of the Brooklyn armatures will necessitate a speed of between 80 and 90 revolutions per minute only.

THE new reservoir for Cardiff, situated in Taff Vawr Valley, Breconshire, was formally opened on the 14th inst., in the presence of the Cardiff Corporation. The undertaking has cost over £374,000.

THE second large iron caisson, constructed by the Barry Graving Dock and Engineering Company, for use at the new Commercial Graving Dock, was launched on the 9th inst., from the yard of the builders. There was a large crowd of people present to witness the ceremony, which passed off very successfully.

Practical Electrical Units.—II.

The Ohm—the Unit of Resistance.—In the previous paper the experimental method of determining the ampère was described, and it will be well now to point out that such a determination may be readily checked by inserting in the circuit an ampère-meter or ammeter. An ammeter is a direct reading instrument so arranged that the magnetic effect, say, of a current in ampères is indicated on a dial by means of a pointer, thus doing away with the necessity of weighing, etc. It may here also be pointed out that the method of determining the ampère is the method of calibrating an ammeter.

Now let us suppose that we have determined the strength in ampères of a current from two bichromate cells by means of a copper voltameter; and further, that when a good ammeter takes the place of the voltameter the number of ampères indicated by it is the same. Let Fig. 1 represent the arrangement, where B is the battery of two bichromate cells, A the ammeter, and w and w_1 the connecting wires, which should be short and thick. In passing we may remark that any material which allows a current of electricity to pass through it is said to conduct electricity, and in consequence is called a "conductor." If now a column of pure mercury (M), exactly filling a glass tube 106·24 centimetres long, having 1sq. millimetre in section, be inserted in the circuit at M, it will be noticed that the ammeter registers a smaller number of ampères (say x ampères); whilst if a similar column of mercury 212·48 centimetres long (twice the length of the first) takes its place, the reading will now be approximately $\frac{1}{2}x$, thus indicating that different conductors affect the strength of the current. It thus appears that the first column of mercury obstructs or resists the passage of the current traversing it, and that the current encounters twice the obstruction or resistance in the second case. In other words, the first column of mercury conducts electricity better than the second column, and the property of a conductor to hinder the flow of electricity

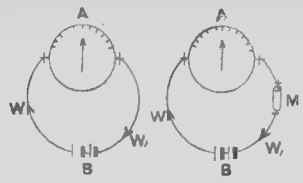


FIG. 1

is termed resistance. Resistance, then, may be defined as the obstruction which a current of electricity encounters when traversing any electrical path. It is obvious that the resistance of conductors plays a most important part in the distribution of electrical currents, and in actual practice it is almost as important to determine the resistance of a conductor as to determine the strength of the current, since, as we have just seen, it is a factor which may materially affect the current's strength.

The unit of resistance is the only one of the electrical units that has been legalised, and when the units of current strength and resistance are understood, it is possible and oft n convenient to define all the other units in terms of these two. Now, if the wires w and w_1 offer so little resistance to the current that the resistance of the second column of mercury is sufficient to decrease the ampèrage from x ampères to $\frac{1}{2}x$ ampères in the above experiments, we may conclude that if the resistance of the first column equals the unit of resistance, then the resistance of the second column is two units. What is the value and name of such unit? At the International Congress of Electricians, held in Paris in 1884, it was decided that the unit of resistance should be "the resistance which is offered to the flow of electricity by a column of pure mercury 106·24 centimetres long, one square millimetre in sectional area, at a temperature of 0° C." Such is the legal unit of resistance, or the legal ohm (in honour of the famous physicist, Dr. G. S. Ohm), by which we compare the resistances of various substances. We are now in a position to understand the chief factors upon which the resistance of any conductor depends. Those factors, which individually affect the resistance of wires are the material, the dimensions, and temperature. The strength of the current itself does not exert any influence upon the resistance of a conductor through which it is flowing, unless it changes the physical state of the wire—as, for instance, by raising the temperature of the conductor.

To understand the action of these factors and to determine the laws of resistance, we will consider them separately in the order mentioned. Though it is obvious that the resistance in any circuit should not be so

great as to produce waste, yet it is very convenient sometimes that different substances vary in their relative resistances—*i.e.*, that resistance is a physical property of the substance itself. Now, whenever a certain physical property varies in different substances, it is usual and necessary to select a certain material as a standard one for reference. So it is with resistances; we employ a constant quantity whose value depends upon the material and is numerically equal to the resistance at 0° C. which a centimetre cube (a cube whose side is 1c.m. long) of the material offers to the flow of the current. This constant is termed the "specific resistance" of that material, whilst the current or ratio got by comparing the specific resistance of a substance with that of the standard substance is known as the "relative specific resistance," which may be defined as "its relative resistance as compared with the resistance of the standard material of similar dimensions and under exactly similar conditions."

An example will make this clear. The resistance between the opposite faces of a centimetre cube, made of silver, is 0·000001504 of an ohm, whilst the resistance of a similar cube made of platinum is 0·000009057 of an ohm. These numbers, then, are the specific resistances of silver and platinum; and as silver, of all metals, has the least resistance, it is taken as the standard of reference, so that its relative specific resistance is 1, and that of platinum is $\frac{9057}{1504}$, or 6.

It will be noticed that the specific resistances of the metals mentioned, when expressed in ohms, are extremely small in value; consequently it is usual to express them in microhms or millionths of an ohm. The specific resistance of silver in microhms will be 1·504, and that of platinum 9 057 microhms.

The two dimensions which enter into our consideration, as regards resistances, are length and area or cross-section of the conductor. We have already inferred in the experiment what the effect of increasing the length of a conductor will be. It is obvious that the resistance is directly proportional to the length. Increased length brings increased resistance. The variation of resistance with sectional area also presents little difficulty, especially if we consider the effect of doubling the cross section of a pipe through which water flows. Such a change would allow twice the amount of water to pass; so it is with conductors and electricity. Such an increase in the cross-section of a wire allows twice as many ampères to pass, therefore the resistance is halved—that is, the resistance varies inversely with the area of cross-section. Collecting what we have said respecting the factors, material, and dimensions, we get the following three laws of the resistance of conductors:—

1. The resistance of a conducting wire of a given length and thickness depends upon the specific resistance of the material.
2. The resistance of a conducting wire is proportional to its length.
3. The resistance of a conducting wire is inversely proportional to the area of its cross-section.

It will suffice to mention, with regard to the effect of the temperature, that the resistance of a metallic conductor increases as the temperature rises, but for equal increments of temperature the increase is less at higher temperatures than at lower ones.

(*To be continued.*)

Machine Construction.

The Construction of Machine Elements.

(*Continued from page* 89.)

§ 135.

INCLINED DOUBLE-LOADED AXLES, RAILWAY AXLES, AND CRANE PILLARS.

The previous methods are almost as easily applied when the loads act in an inclined direction. The inclined action is caused by various conditions, and as an example we will consider railway axles.

Besides the vertical load Q at the centre of gravity S, of the car, Fig. 403, there are forces due to centrifugal action and flexibility which produce a horizontal force, which Scheffler, according to Wöhler's researches, places at 0·4 Q,* so that there is an inclined resultant R, acting upon the axle. Since the value 0·4 Q was obtained by means of measurements on cars during long runs, it includes the action of the elevation of the outer rail in passing curves. This force R is also acting on the wheel flanges at K_1 and K_2, as well as those at the journals A and D. It must be noted that

*Ad. Scheffler: "Railway Axles." Braunchweig.

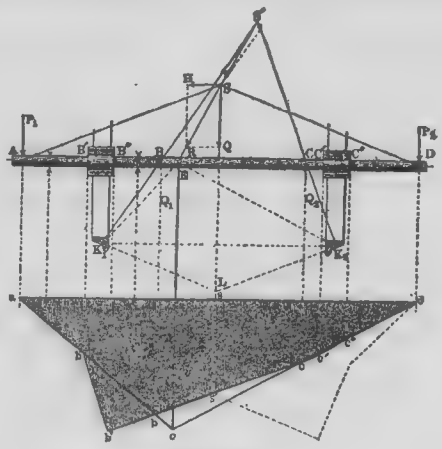


Fig. 403.

the wheel K_2 opposed to H can only resist forces acting normal to the coned face, so that the angle L K_2 S′ should be made = 90°.

The points of intersection B and C of the wheel forces on the axle give the positions for the verticals Q_1 Q_2, and the horizontal pressure may be neglected in determining the axle load, these being P_1 and P_2. From these the journal diameters are found, and the greater taken for both.

Then from the point of application E of the resultant R let fall a perpendicular E *e* and draw the triangle *a d e*, prolong the direction of Q_1 and Q_2 to *b* and *c*, and join *b* and *c* by a straight line. Then drop perpendiculars from B′ B″, C′ C″, to *b′ b″*, *c′ c″* and join these latter, and *a b′ b″ c′ c″ d* is the cord polygon for the given conditions. The ordinate *t* serves to determine the diameter *y* for any journal diameter d_1, and the ordinate t_2 gives the root of the journal.

The direction of K_1 B is readily determined as follows:—Choose any point on the line of R—as, for example, E—join it with K_1 and K_2, and decompose R = E *r*, Fig. 404, along the directions E K_1 and E K_2 into E k_2 and k_2 *r* = E k_1, draw k_2 *l* horizontal and E *l* parallel to the given direction S_2 S′; then *l* E is the force at K_2, and *r l* that at K_1, whose direction is sought, while E k_2, and k_2 *l* are the inner forces at the corner K_2 of the cord polygon E K_2 K_1, and in equilibrium with the force of the known direction K_2 S′.

Since the horizontal force H acts either to the right or left, the larger size of the polygon *a s s′ b″ b′* must be used for both halves of the axle, as shown in the dotted lines. The cord polygon for the direct vertical load should also be drawn, and if it gives a greater ordinate for the shaft than *s s′*, it should be used, the diameter of the shaft generally being smallest in the middle.

Axles of railway cars make from 250 to 300 revolutions per minute. For wrought iron the journals are generally made two diameters in length. In passing around curves these journals are subjected to considerable endlong pressure. The shoulder *e* is generally made = ½ *d* to ⅔ *d*, and heavier than usual in ordinary cases.

In many countries standard proportions for axles have been adopted. Those of the Prussian railways are as follow, the dimensions depending upon the value of Q, which is the total load on each axle:—†

Q = 3,800kilos.	D = 10″mm.	*d* = 65mm.
,, = 3,500 ,,	,, 115 ,,	,, 75 ,,
,, = 8,000 ,,	,, 130 ,,	,, 85 ,,
,, = 10,000 ,,	,, 140 ,,	,, 95 ,,

The journal length *l* varies between 1¾ to 2¼ *d*, according to judgment. These proportions are for wrought iron; if steel is used Q may be increased by 20 per cent. For iron axles the pressure upon any one journal should not exceed ⅔ Q. These figures give a stress of 6·4 to 8·3kilos. per square millimetre, or 8000 to 12,000lb, and the pressure *p* from 0·30 to 0·41kilos., or 326 to 593lb.

In Fig. 405 is shown a steel axle for the Royal Eastern Railway, with its wheels, all dimensions being in millimetres.

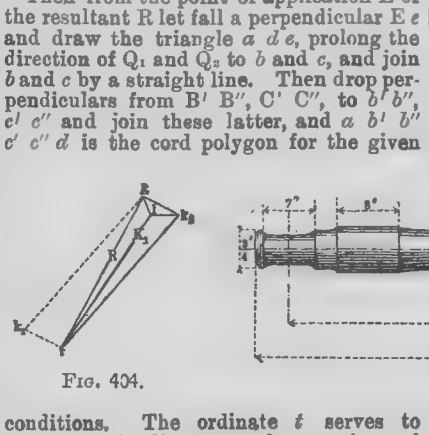


Fig. 404.

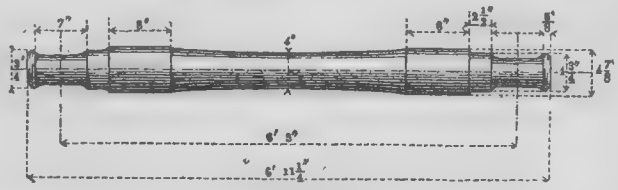


Fig. 406.

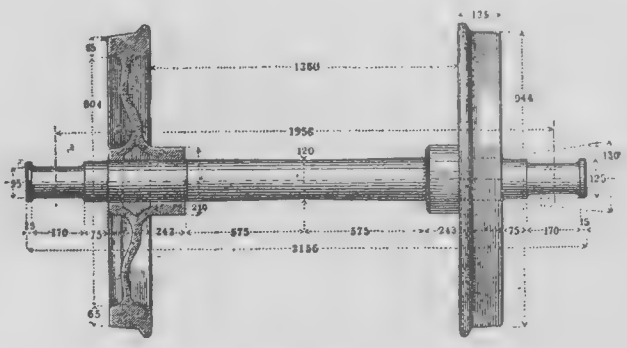


Fig. 405.

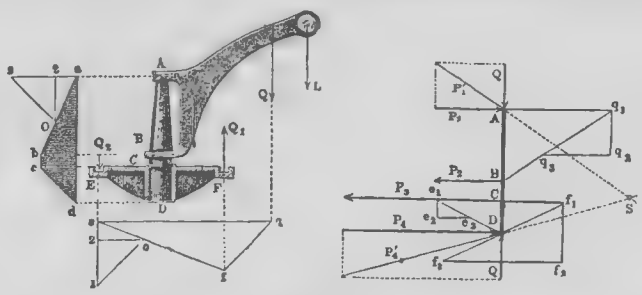


Fig. 407.

In England a standard axle has been adopted, as shown in Fig. 406,‡ and the standard American axle is similar.§ The value of Q in this case is about 22001b. In France there has been no general standard adopted, but the various roads have adopted forms—for regular use. The Paris-Lyons-Mediterranean Railway has eight forms. One of these has *d*=85mm. (8⅜in.), *l*=170mm. (6¾in.), length between centres of journals 1925mm. (75¾in.), diameter of hub-seat = 125mm. (4¹⁵⁄₁₆in.), diameter of the axle in the middle=105mm. (4⅛in.).

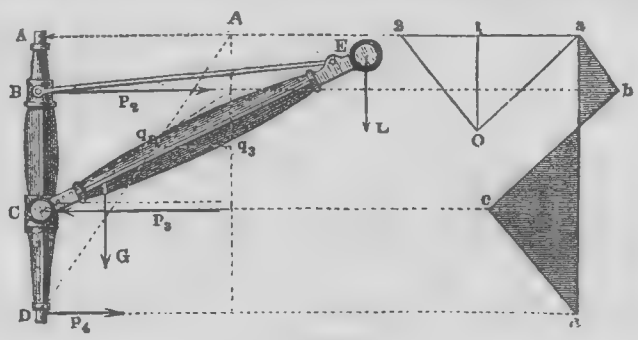


Fig. 408.

† These dimensions are given in the metric system as representing Continental practice.

‡ See "Engineer," November, 1873.

§ See "Engineer," June, 1873. The M. C. R. standard varies slightly from the above (Trans.).

Crane pillars may be considered as axles subjected to inclined stresses, as the following example will show. The crane shown in Fig. 407 is subject to the load L, and also its own weight G, and the resultant of these is at Q (see example in § 34).

At A and B are bearings, and the pillar is held in a baseplate at C D, the plate being secured at E F; construct the cord polygon *e f g*, and force polygon *e* 2 1 O, in which 2 1 = Q, 1 *e* = Q_1 the force at F, *e* 2 the force Q_2 at E. All three external loads act parallel to the axis, so that we can use the method shown in Fig. 394. In the diagram to the right we make q_1 q_2 = Q, and q_2 q_3 parallel to A q_1 normal to A B. These lines then represent the horizontal forces P_1 and P_2 at A and B.

The bearing at A carries the entire vertical load, and hence we have at A the inclined resultant P_1' of Q and P_1. We now draw C f_1, normal to A C, f_2 f_1 = Q, draw f_1 D and also f_2 f_3 parallel to C f_1, then f_2 f_3 will give the magnitude of a force acting right at D and left at C. In a similar manner, draw e_1 e_2 = Q_2, and draw e_1 D, and make e_2 e_3 parallel to e_1 C, and e_2 e_3 will be the magnitude of a force acting left at C and right at D.

We therefore have $P_3 = f_2 f_3 + e_3 e_2$, and $P_4 = e_2 e_3 + f_3 f_2$. The vertical pressure of the pillar itself is all taken at D, hence we get for its vertical component $Q = f_2 f_1 - e_1 e_2$, which combined with P_4 gives the resultant P_4. This is proved by the intersection of P_1', and P_4' at S must fall on the line of the resultant of P_2 and P_3.

If we neglect the compression in the direction of the axis, we may now draw the force polygon *a* 2 3 O of the forces P_1, P_2, P_3, P_4, as shown at the left of Fig. 407, and thus obtain the surface of moments *a b c d*.

A crane with swivel column, to which the jib or boom is rigidly attached, may be examined, as shown in Fig. 408. The position of Q = L + G is taken as before, making q_1 q_3 represent Q, draw A q_1 normal to the axis, join q_1 D and draw q_2 q_3 parallel to A q_1 till it intersects with q_1 D. We then have q_3 q_2 for the horizontal force P_1 at A, and q_2 q_3 the corresponding horizontal P_4 at D.

The step bearing at D will be subjected to an inclined thrust, the resultant of Q and P_4.

In a similar manner we obtain the horizontal forces P_2 and P_3 equal and opposite, and acting at B and C, and the resultant of the force at B with Q gives the inclined force due to the rod B E. The four horizontal forces have the same action as the load on the axle in Fig. 394. We may thus obtain the surface of moments *a b c d*, which shows a zero point for bending moments between B and D, and also indicates a forward bending above and a backward below. In the force polygon 2*a* = P_2, *a* 2 = P_3, 2 1 = P_4, and 1 2 = P_1.

(*To be continued.*)

The Electric Transmission of Power.‖

Although the use of electricity for power purposes has increased enormously during the past three years—and there are few, if any, who do not daily see this power in operation,—it is a surprising fact that many, perhaps the majority of mankind, do not realise that electricity is not an initial power, but only a convenient form into which energy may be transformed for transmission to some distant point. The newspapers speak of electricity supplanting steam. This is not true in the sense in which the words are used. Electric motors may supplant steam locomotives as the immediate power for hauling cars on railroads, but the steam-

‖ A lecture by Eugene G[illegible] before the Franklin Institute.

power is simply transferred from the locomotive to a large stationary engine at some central station, where it runs the dynamos, and is by no means eliminated from the problem.

The average layman does not reflect that we must have some means of generating electricity, and that the usual method is the application of steam-power to a dynamo. In one sense we must go back to the sun as the original source of energy. For thousands of years the sun has been storing up energy in the form of coal, and we are now using this stored energy for practical purposes. Every lump of coal contains the potentiality of a given quantity of horse-power, or rather from this coal may be obtained a given amount of energy which we measure in units of horse-power. We convert this energy into steam in the boilers, we again convert it into mechanical motion in the engine, again it is changed into electricity in the dynamo, and goes out over the wires to be once more transformed into light, heat or motion.

The advantages of generating power in one place to use in another or in several other places, are too many and too obvious to require consideration. In many cases it is absolutely necessary to generate the power at some distant point. In case of waterfalls we have the power existing and running to waste, and it is only necessary to utilise it as it is. We may, by pipes, canals, and conduits, conduct this water-power to the place where we want to use it, but we can only conduct it downhill. Steam-power can be converted into mechanical power, and by belts and shafting carried in any direction, but the distance is limited, and the loss in power rapidly increases with the distance. Electric-power can be carried in the wires in any direction, up or down, around corners, underground, in the air, wherever the conditions are most favourable, and can be carried longer distances with less loss than any other form of energy. These advantages are so manifest and so important that it is only surprising that electric energy is not more generally used than it is.

Electrical energy is manifested in many ways, and is generated by numerous methods; but the only practical method of generation with which we need be concerned is the dynamo—*i.e.*, closed wire coils revolving in a magnetic field. There are dynamos and dynamos, and it may be well to consider for a moment the different kinds of current which they generate. Dynamos are classified in many ways, as shunt-wound, self-exciting, separately-excited, etc.; but the only differences that I care to examine now are those which affect the character of the current produced. The alternating machine is a dynamo in which electric currents are generated in the armature coils, as these coils approach, come opposite to, and recede from the magnetic fields of one or more magnets. The ordinary machines have six or more electric magnets placed around the periphery of the frame, and the armature turns in close proximity to the magnets and the field coils which surround the iron cores and form part of the magnets. The electrical impulse or current generated in the armature coil as it approaches a magnet is in one direction, and as it recedes from the magnet is in the other direction; and so we have a series of impulses alternating in direction, and which for comparative purposes we call positive and negative. Assuming a neutral line, we represent an alternating current graphically by a wave line with equal ordinates above and below the axis. In the direct-current dynamo we communicate the current—*i.e.*, we so arrange the contacts or connections with the wire that leads the current away from the dynamo, that these contacts change as the impulses change, so that the impulses are always in the same direction in the lead wire, and we have a constant or direct current which we represent graphically by a straight line.

If the constant-current dynamo, with its two fixed brushes, be supplied with a third brush, so arranged that it revolves about the commutator with greater or less rapidity, we have a peculiar result which we call a pulsating direct current. This is used practically to operate a rock drill constructed on the solenoid principle, as follows:—

The upper and lower brushes are fixed; the third, or revolving brush, is shown in its neutral position. When in this position, or when it has revolved 180° from this position, there is manifestly no current in the third or middle wire. As the revolving brush approaches the upper brush, the middle wire takes part of the current of the upper wire, and as it approaches the lower brush it takes part of the current of the lower wire. The result is an alternation of pulsations through the upper and lower halves of the solenoid varying in rapidity directly with the rapidity of rotation of the third brush. The drill in the solenoid is drawn up and down with rapidity dependent upon the rapidity of the electrical impulses.

You have all doubtless heard of the long-distance power-transmission installation recently exhibited at the Frankfort Exhibition in Germany. In this installation still another kind of current is used, called the three-phase current. Three separate impulses are generated in each revolution of the armature, each lagging 120° behind the previous impulse. This dynamo is practically an alternating dynamo, and the current generated bears somewhat the same relation to the ordinary alternating current that the pulsating direct current does to the ordinary simple constant current obtained from a two-brush machine.

In the electrical transmission of power are involved four elements:—

(1.) The original power.
(2.) The generator.
(3.) The line.
(4.) The motor.

The original power is usually steam; sometimes water. If the power consumed at the other end of the line is constant—*i.e.*, if the load on the engine is constant, or if the changes in the load are gradual,—the problem is simple, so far as the steam engine is concerned, and any of the ordinary types of engine will do the work. For street railway and similar work where the loads are variable, especially strong engines are required to stand the enormous strains resulting from the sudden and very violent fluctuations. The same build of engine which did very good work in an electric-lighting station was found to be too light for railway work.

(*To be continued.*)

Shipbuilding Notes.

Messrs. Russell and Co. launched from Kingston Yard, Port-Glasgow, on the 14th inst., a three-masted sailing ship. The vessel registers 1750 tons, and is capable of carrying 3000 tons cargo.

Messrs. Wighman, Richardson and Co. launched from their Neptune Shipyard, Low Walker, on the 10th inst., a steel screw steamer. The vessel is 285ft. in length by 38ft. beam. The triple-expansion engines and the boilers are being constructed by the builders.

The "Euphrates," troopship, made a successful trial of her engines at Portsmouth on the 14th inst. With 48 revolutions a minute 3020H.P. was developed, and an average speed of 12½ knots by log was realised, which was less than the actual result.

The new contract-built first-class cruiser "Blenheim," 9000 tons, 20,000H.P., has been completed in Chatham Dockyard, in readiness for her steam and gunnery trials. The "Blenheim" is intended to relieve the "Boadicea" as the flagship of the rear-admiral commanding-in-chief on the East India Station.

On the 12th inst., Messrs. Sir Raylton Dixon and Co. launched from their Cleveland dockyard, Middlesbrough, two steam trawlers, of the following dimensions:—Length over all, 107ft. 8in.; breadth, 20ft. 2in.; depth moulded, 11ft. 8in. The engines will be fitted by the North-Eastern Marine Engineering Company Limited, of Sunderland, the cylinders being 16in. by 32in. and 22in. stroke.

There was launched on the 10th inst., from the west yard of Messrs. C. S. Swan and Hunter, shipbuilders, Wallsend, a large steel cargo screw steamer. The dimensions are:—Length, 322ft.; breadth, 41ft.; depth moulded, 23ft. 1½in. The engines, which have been built by the North-Eastern Marine Engineering Company, Wallsend, are of the triple-expansion type. The vessel is rigged as a two-masted schooner, her gross tonnage being 2900.

Messrs. Fleming and Ferguson, ship-builders and engineers, Paisley, launched, on the 15th inst., a steel screw self-propelling combined sand pump and bucket hopper dredger, built to the order of Messrs. A. Macpherson and Co., Greenock, for harbour work at Mexico. Her dimensions are 150ft. by 30ft. by 12ft. 6in. She will be capable of raising 300 tons per hour from a depth of 35ft., and of carrying 300 tons. Her engines are of the compound surface-condensing type, and will indicate 300H.P.

It is reported that Messrs. Harland and Wolff, Belfast, have secured an order from the White Star Line, to build a transatlantic steamer which will eclipse anything yet afloat. She will be 700ft. long and 65½ft. broad. Her engines will develop 45,000H.P., or 15,000H.P. more than the Cunarders. She will speed from port to port at 22 knots an hour, and will have a maximum speed of 27 knots. She is expected to cross the Atlantic under five days. The dimensions of the famous "Great Eastern" were: Length, 679ft., and breadth 82ft. From this it will be seen that the new White Star Liner, though not so broad, will be 21ft. longer than the "Great Eastern."

Modern Systems of Refrigeration in Ships.

ALL the great innovations that have been introduced during recent years may be said to owe their origin to certain causes, occult or otherwise, that have individually and collectively brought about such changes. It has been so in manufactures generally, and in steamships and their machinery in particular, and especially so in reference to the now most important branch of engineering known as "Mechanical Refrigeration." Here, however, let us retrace our steps to the period when this system was practically unknown.

Amongst the "forties," when the writer was a very youthful resident in Australia, the cattle which that country so abundantly produced were most extensively boiled down for the sake of their hides, horns, and tallow, which were subsequently stuffed into the holds of ships bound for London, until in some cases these vessels were dangerously overloaded. In this manner a profitable market was found for these products, whilst the meat that once bound them all together was thrown away as refuse, the result being that whilst the other necessaries of life were sold at high rates, the value of cattle became greatly lessened, and beef and mutton could be had for almost nothing.

One of the leading peculiarities of modern times is the skilful utilisation of waste products, or at least those products for which there is apparently no further employment, and it is here where, in many cases, handsome profits may be made when under other circumstances losses would be incurred.

It is surprising, says Mr. J. W. C. Haldane, in the monthly report of the Marine Engineers' Union, how a great scientific discovery sometimes affects the commerce of the world, and perhaps revolutionises a whole branch of manufacture, either in its technical operations or in some other way.

Of these we have had many examples, and certainly one of the best of them is the system of refrigeration now so extensively adopted on board ships and in cold storage warehouses, etc. In Australia, at the time to which we have referred, the only method of continuously preserving meat in a good condition was to pickle it, and therefore the staple food up the country, and even on board high-class passenger ships, was salt beef and pork, which many of my contemporaries will no doubt feelingly remember. In course of time someone found out that the scientific application of artificial cold had certain useful properties, which, after further investigations, proved so important as to lead eventually to its universal introduction.

The great industry of New Zealand is sheep grazing, originally on account of the fleeces thus obtained, but in recent times for both the wool and mutton the animals produce, and so enormously has the export of the latter increased that its value now exceeds £20,000,000 per annum. Up to the year 1881 the inhabitants of the above territory had a mine of wealth at their feet, and our own islanders a grand source of household economy, which none of them ever thought of until they were shown how one of the forces of Nature could be advantageously utilised on their behalf, thus benefiting directly millions of beef and mutton producers and consumers in both hemispheres, and opening out new avenues to prosperity in many other ways.

During the above year it became evident that meat could be sent in a frozen and perfectly marketable state across the seas. This caused great alarm and opposition amongst the butchers, but not without good reason, as the New Zealanders soon appreciated the invention, gradually perfected their machinery, and established freezing works near the seaports from which the frozen carcases were transported to the refrigerating chambers of steamers.

The freezing compartment of a ship forms a very good and curious example of the application of a scientific fact to a practical purpose, and nowhere perhaps is this more observable than in the long-voyage liners. The principle upon which these chambers are constructed is as follows:—

In all air there exists a quantity of sensible or insensible heat, which maintains it at a certain bulk, and can easily be taken from it. Hence it happens that when—for refrigerating purposes—the atmosphere is compressed into a cooler or receiver to about one-fiftieth of its original volume, a large quantity of heat is produced, which is subsequently abstracted by the circulation of sea water throughout the chamber. The air is now liberated from the cooler, but while attaining its former bulk in an expansion cylinder it produces the most intense cold. Thus it will be seen that when meat or any other perishable substances are enclosed in a refrigerating compartment, they become frozen, and are maintained in this condition for any desired period whilst being kept in an atmosphere having a temperature of about 20° F.

The importance of utilising this artificial method of freezing may be still further explained:—The air we breathe is charged more or less with life germs, which have no affinity for timber, metals, stone, or ice, etc. For meat, however, they have a strong attraction, hence in a short time these germs settle down and take root in the flesh, thus creating putrefaction, until eventually they produce a mass of hideous corruption, which the application of the aforesaid process would have prevented. Not only is this the case with the aforesaid beef and mutton derived from millions of colonial and foreign sheep and cattle, but also with birds, fish, fruit, and other similarly perishable commodities that are now transported across the seas for home consumption, or for supplying the commissariat departments of long-voyage passenger liners.

Various methods are used to accomplish the desired end, particulars of which have been kindly given by the Linde British Refrigerating Company, and by Messrs. J. and E. Hall, of Dartford, and the Haslam Engineering Company, of Derby, all of whom are well known in this special department of science. The means employed by the first named may be described under the title of the dry-air ammonia system, which is the invention of Professor Linde, of Wiesbaden, who has succeeded in introducing it most successfully to very many firms at home and abroad for artificial ice making, and for a variety of other purposes afloat and ashore. This arrangement differs materially from what is known as the dry-air system, and is becoming very popular in ships, according to the peculiarities of the station on which they are employed.

In long, and sometimes in short, voyage vessels, the compressed dry-air system is greatly used, as the supply of air is unlimited, and costs nothing. Like many other good things, however, it had its failings, and these so exercised the mind of the inventor that he at last devised his own system, which is now most extensively employed at home and abroad, and in many of the largest steamers, including the White Star s.s. "Teutonic" and "Majestic," and in most of the transatlantic liners.

In each of the vessels just named, the refrigerating machinery is used for freezing the contents of two meat holds, having a total net capacity of 40,000 cubic feet, and also the provision rooms. Each hold is provided with separate fittings, so as to allow its own refrigerator to work either hold, or one refrigerator both holds when required. On account of the limited available space in each ship, the machinery is placed below the holds and between the screw tunnels, and thus it became necessary to employ two separate engines instead of those of the duplex type now so generally preferred, but which, under the circumstances, proved a very satisfactory arrangement.

The system of cold production on the above principle is based upon the evaporation of liquid anhydrous ammonia, which boils under atmospheric pressure at about 30° below zero F. This low evaporating pressure is produced and maintained by means of a small pump, which draws off the vapour as quickly as it is produced, and then compresses and discharges it into a vessel termed the condenser, in which the ammonia vapour is rendered fit for use again in the refrigerator or evaporator. The ammonia condenser consists of a series of wrought-iron coils, each in one length of tube, so as to avoid inaccessible joints. The coils are attached to one of the end covers of the bedplate of the engine, so that when required they can be readily drawn out for examination by merely removing the nuts of the bolts or studs fixing the cover. When the machine is in operation, cold water is circulated around the coils by means of a pump, so as to carry off the heat given up by the ammonia in passing from the vapourous to the liquid state.

The refrigerators in which the liquid ammonia is evaporated consist of a series of wrought-iron tubes wound in such a manner as to get the largest amount of surface into the smallest amount of space. There are two sets of coils, one to each machine, but one of the sets is again divided into two, in order that the refrigeration of the passengers' provision rooms can be carried on independently of the meat holds. The coil spaces are below the meat holds, and are well insulated with wood and charcoal, in order to prevent the passage of heat from the machine room, which, owing to its position, becomes extremely

hot in warm weather. The holds and provision rooms are cooled by means of currents of cold air produced by Blackman propellers, driven by independent engines. These fans draw the air from the holds and simply *pass it over the coils* in which the liquid ammonia is being evaporated. In this way the air is made to supply the heat required to evaporate the ammonia, and in so doing it becomes cooled to an extent which depends upon the quantity of air circulated through the holds by wooden trunks in the usual manner.

The chief advantage claimed for the Linde refrigerating system is the great economy of fuel, which is stated to be only about one-fifth of that required with the ordinary cold-air machine, owing to the absence of compression, while the first cost is considerably less, and the space occupied about one-half. Besides this it may be stated that while in a 12-ton ice machine, for instance, the charge of ammonia costs in England about £22, the cost in one year of night and day work is only about £5.

In addition to the steamers already named, many other meat-carrying vessels have been fitted with refrigerating machinery on the Linde system. For large ships a duplex machine is generally adopted, there being two compressors, each being driven direct by steam cylinders, which can be worked separately or together. When the whole machine is in operation, the two steam cylinders form a compound engine; but in case of necessity, the crank shafts can be disconnected, and one compressor and one engine alone worked satisfactorily as usual.

(*To be continued.*)

On Shipbuilding in Portsmouth Dockyard.

(*Continued from page* 110.)

Expenditure.—Under the Naval Defence Act of 1889 the expenditure on new construction at Portsmouth, as well as at most of the other home dockyards, has been relatively increased. Large sums necessarily have to be expended also on the repairs and maintenance of the fleet, and on other services. The magnitude of the operations at Portsmouth is indicated by the following figures, taken from the Navy Estimates for the current financial year, 1892-93:—

ESTIMATED EXPENDITURE.

	Labour.	Materials.	Total.
	£	£	£
New construction....	253,450	124,380	439,830
Reconstruction, repairs, etc., of fleet..	134,150	65,750	199,900
Miscellaneous services, manufactures, work for other departments, etc.	149,110	65,390	214,500
	£538,710	£315,520	£854,230

It will be seen that nearly half the estimated expenditure on labour and more than half the expenditure on materials are to be devoted to new construction. At present about 7500 men are employed in Portsmouth dockyard. About 60 per cent. of these are in the shipbuilding department, under the Chief Constructor; 25 per cent are employed under the Chief Engineer; and the remainder are distributed in other departments.

Past Shipbuilding.—In this paper it is impossible to give even a summary of past shipbuilding operations at Portsmouth, but from a list of typical vessels built during the last thirty-three years, the "Prince of Wales," "Duncan," and "Victoria" were splendid examples of the screw line-of-battleships, with wood hulls and unarmoured, which formed the main strength of the navy when the ironclad reconstruction began. The "Victoria" was the largest three-decker launched at Portsmouth. It may be interesting to add that the cost of such a ship, including machinery, but excluding armament and ordnance stores, was about £230,000. This was about three times the cost of a 100-gun line-of-battle ship at the beginning of the century, and about twice that of the 110-gun sailing line-of-battle ships of 1840. On the other hand, it is less than one-third the cost of a first-class battle-ship of the present day.

The "Royal Sovereign" of 1864 was launched in 1857 as an unarmoured line of-battleship. In 1862 her conversion into an armoured turret-ship of low freeboard was begun on the plans of Captain Cowper Coles, R.N. The upper works were cut down, and the weight saved in this way and by other changes was devoted to armour-plating the hull and the turrets. She was the first armoured ship produced at Portsmouth, and was tried in 1864.

The "Royal Alfred" was another converted ironclad, armed on the broadside principle, with high freeboard and good sail power. She was one of a considerable number of such vessels built when a resolute attempt was being made to overtake the French in the ironclad reconstruction.

The "Devastation," laid down in 1869, was the first iron-hulled armoured ship built at Portsmouth. She has other claims to notice. Originally designed as a breastwork monitor, with low freeboard to the upper deck, she was altered during construction by adding light superstructures; and as completed was the pioneer of the numerous class of seagoing turret-ships with moderate freeboard and a few heavy guns which are now on service in the navy. Sail-power was abolished; duplicate engines and twin-screws were trusted to entirely for propulsion. After nearly twenty years' service the "Devastation" may now be seen in hand at Portsmouth for a complete refit, which includes the removal of the old horizontal engines and the boilers carrying only 30lb. steam-pressure, and the substitution of vertical triple-expansion engines and boilers working at 145lb. pressure. The turret armament will be altered also to 10in. 29-ton breech-loaders. In this way the steaming capability and fighting efficiency of the ship will be much increased. Her iron hull is as sound and strong as ever. The first cost of the "Devastation," excluding guns, ammunition, stores, and incidental charges, was about £360,000.

The "Shah" and "Boadicea" are unarmoured cruisers, with iron hulls wood-sheathed and coppered for service on distant stations where docking facilities do not exist. At the time of their construction they were notable for high speed, powerful armaments, and good sail power. The "Boadicea" is still on service as flagship in the East Indies. The "Shah" is now at Bermuda, employed as a stationary ship. She will long be remembered for her fight with the Peruvian turret-ship "Huascar."

The "Inflexible," commenced in 1874, was the largest ironclad constructed for the navy up to that date, and her displacement was not again equalled until the construction of the "Trafalgar" in 1886-90. She is a turret-ship of moderate freeboard, and was the first of the central-citadel type. Her design grew out of the report of the Committee on Designs appointed by the Admiralty in 1871, with Lord Dufferin as chairman, and great controversy arose respecting the arrangement of the armour. She is remarkable not only for her size, but for other qualities. Her hull carries the thickest armour of any ship in the navy. It is of iron in two thicknesses, which together make up as much as 24in. Her turrets carry steel-faced iron armour in two thicknesses, amounting together to 17in.; they contain four 80-ton guns, the heaviest muzzle-loaders afloat. She was the first of the battle ships to be fitted with internal electric lighting and with submerged tubes for discharging torpedoes. Many changes and additions were made during her construction, and she was about seven and a half years in hand, costing over £812,000, exclusive of armament and establishment charges. She played a prominent part in the bombardment of Alexandria. Having been thoroughly refitted, she is now on service in the Mediterranean.

The "Colossus" is a smaller central-citadel turret-ship, carrying modern breach-loading guns, with steel hull and steel-faced iron armour. Her capabilities as a steamer are much superior to those of the "Inflexible"; but in thickness of armour and weight of armament she is inferior to the larger ship. She is now in the Mediterranean on active service. Her first cost on the same basis as for other ships was about £662,000.

The "Impérieuse" is officially classed as an armoured cruiser, although she compares favourably with many vessels ranking as battleships in foreign fleets. She possesses high speed, and is an excellent steamer. Her bottom is sheathed with wood and copper. Her armament and armour are moderate in character. At present she is serving as flagship on the China station. Her first cost was £544,000.

The "Camperdown" is a barbette ship of the "Admiral" class, carrying a powerful armament, with armour of considerable thickness, but limited in area on the hull. She possesses high speed and a large coal supply. Respecting the defensive powers of this class also there has been much debate. Apart from this feature, the class has found much favour. Three years' working in the Channel Squadron has established their reputation as good steamers and excellent sea boats, while the arrangement of the armaments is generally approved. The heavy guns, mounted in barbettes, are carried considerably higher above water than in most turret and broadside ships. Although Portsmouth has built only the "Camperdown" of this class, three other vessels built at Pembroke—the "Collingwood," "Howe," and "Anson"—came to Portsmouth in an incomplete state, and were here made ready for service. This fact is mentioned because it illustrates a section of work on new ships, of which a large share has fallen upon Portsmouth, Pembroke yard not being equipped for finishing large ships for sea. The first cost of the "Camperdown" was about £677,000.

The "Trafalgar" and her sister ship the "Nile"—the latter having been built at Pembroke and completed at Portsmouth—are the two most powerful turret-ships afloat. They are of moderate freeboard, like the "Inflexible," but are armoured on a different principle, and exceptionally well protected. The armament is very powerful, and includes not only four 67-ton guns carried in two turrets, but also six 4·7in. quick-firing guns mounted on the broadside in a protected central battery. The "Trafalgar" has an immense advantage over preceding turret-ships in this arrangement of the auxilary armament. She is an excellent steamer. Her keel was laid in January 1886, she was launched in September, 1887, and commissioned for service in the Mediterranean in April, 1890. The time occupied in her construction was much less than that spent in building the battleships which preceded her. The cost of the construction was relatively less; excluding armament and incidental charges, it amounted to about £740,000.

(*To be continued.*)

Notices of New Books.

DYNAMOMETERS AND THE MEASUREMENT OF POWER. By JOHN J. FLATHER. New York: John Wiley and Sons.

NOTWITHSTANDING the importance of accuracy in power measurement, and the number of dynamometers which have been devised from time to time for the purpose, the literature on the subject is meagre in the extreme. Of late years, however, increasing attention has been given to dynamometric measurements of power, by reason of the scepticism with which the more ordinary forms of friction brake dynamometers are regarded. Mr. Flather's treatise is welcome, not only as containing illustrated descriptions of the most modern forms of dynamometers, but also as a treatise on power measurement which will commend itself to the engineer as well as to the technical student. In the first chapter an interesting table is given showing the percentage of horse-power required to drive the shafting in various works and manufactories. The proportion varies considerably, being as low as 15 per cent. at the works of Messrs. J. A. Fay, wood-working machinists, and reaching 80 per cent. in the case of the Baldwin Locomotive Works. Chapter II. deals with friction brakes, and contains illustrations and descriptions of several of these instruments. The absorption dynamometers selected for description are the Richards, the Alden and Froudes water brake. In Chapter IV., transmission dynamometers are discussed, and a number of instruments described, including the author's hydraulic dynamometer. The power required to drive lathes is briefly discussed in Chapter V., while Chapter VI. is devoted to a somewhat lengthy explanation of the measurement of water power. Mr. Flather's treatise fills a gap that has long existed in engineering literature, and it should prove of service to the engineering student, as well as to the multitude of practical men interested in the measurement of power.

POCKET-BOOK FOR MINERS AND METALLURGISTS. By F. DANVERS POWER. London: Crosby Lockwood and Son. 9s.

THIS is a collection of rules, formulæ, tables, and notes specially compiled for those engaged in mining and metallurgical industries, and calculated to be of great service, especially to those engaged in field work, as it contains concise notes bearing on the various sciences connected with metal mining. We find sections on arithmetic, algebra, and mensuration, tables of logarithms, sines and tangents, as well as a useful collection of weights and measures, money tables, etc. Sections are also given on heat, electricity, air and water, mechanics, hydraulics, strength of materials, chemistry, assaying, mineralogy, geology, ore dressing, etc. We are inclined to think that there are few points of interest to the mining engineer but what will be found treated on in this volume. In compilations of this description there is, of course, always a difficulty experienced in deciding what to include and what to omit; but we are of opinion that Mr. Power has made the best use of the space at his command, and succeeded in producing a pocket-book which certainly deserves to become the mining engineer's *vade mecum*. We may add that the book is exceedingly well printed on white paper, and strongly and neatly bound.

Trade Notes.

The Wolverhampton Corrugated Iron Company are enlarging their works at an outlay of £5000.

Messrs. Baikie Brothers, Aberdeen, are supplying the girders required for the Dundee electric-lighting station.

Messrs. F. C. Royce and Co., Manchester, have completed an electric-lighting plant at Stanley Colliery, Stanley.

Messrs. Craig and Donald, Johnstone N.B., are fitting up a new pair of shears at their works, weighing over 90 tons.

The Glenfield Company Limited, Kilmarnock, have secured the contract from the Corporation for penstocks and valves.

Messrs. R. Stephenson and Co., Hebburn-on-Tyne, are constructing three pairs of gates for the Barry Docks, South Wales.

Messrs. J. Butler and Co., Stanningley Ironworks, Leeds, are preparing plans and estimates for the new pier at Morecambe.

Messrs. J. Copeland and Co., of Glasgow, have shipped a complete tube-making plant to St. Petersburg for the Russian Government.

The Victoria Collieries, Bruntcliffe, near Leeds, are inviting tenders for laying about 2000yds. of 60lb. flat-bottomed rails for a colliery siding.

Messrs. Norman and Co. Limited, Glasgow, have received instructions to fit up an electric installation at the Orchard Sugar Refinery, Greenock.

The North-Eastern Steel Company, of Middlesbrough, have obtained a contract for 959 tons of rails from the New Zealand Midland Railway Company.

The directors of Sir W. G. Armstrong, Mitchell and Co. Limited, have decided to recommend a dividend for the year ending June 30 last, at the rate of 9½ per cent.

The General Electric Power and Traction Company have completed an installation of electric light at the Greenside Silver Lead Mines, at the head of Ullswater.

Messrs. Willans and Robinson, Thames Ditton, are supplying the Whitehaven Town and Harbour Trustees with four sets of Willan engines and Crompton dynamos.

Messrs. Victor Coates and Co., Lagan Foundry, Belfast, have been commissioned by the Brookfield Spinning Company to construct a set of vertical triple-expansion engines.

The directors of W. T. Henley's Telegraph Works Company Limited announce a dividend at the rate of 7 per cent. per annum on the preference shares for the six months ended June 30 last.

Messrs. John Deas and Co., Glasgow, have contracted with the Glasgow Market Commissioners to supply the iron railings required for the cattle market. The amount of the contract is £801.

The Crompton-Howell Electric Power, Light and Storage Company, Llanelly, have erected an extensive pumping plant at the Aberdare-Merthyr Colliery, which is the property of the Aberdare-Merthyr Collieries Company.

The Vevey Engineering Works are completing plant for the electrical transmission of 300H.P. by continuous currents for the Monthey Sugar Factory. The motive power will be obtained from the Viège, a tributary of the Rhône.

Messrs. Hudson and Co. Limited, Excelsior Steel Tube Works, Birmingham, have opened their new Bournbrook Works. The whole of the machinery and engines have been supplied by Messrs. Finney Bros., of Birmingham.

The two new steamers for the Inman and International Company will be built on the Clyde. One will be built by Messrs. Robert Napier and Sons, of Govan, and the other by Messrs. Denny Brothers and Co., of Dumbarton.

The Government of Madras have sanctioned the purchase from Messrs. John Fowler and Co., Calcutta, of an additional half-mile of portable railway for use on the head works of the Periyar project at an estimated cost of Rs.3000. Hitherto it has been the custom to obtain such material through the India Office in this country.

Wheel cutter in metal only. Every description of gearing. R. CHIDLAW, 43, City-road, Manchester.

Having regard to the enormous circulation of THE MECHANICAL WORLD, the Editor suggests that it is by far the best medium for the insertion of every kind of "Wanted" advertisement, and the price is only one half-penny per word. The Editor will be glad if MECHANICAL WORLD readers will kindly bear this in mind as occasion arises.

The Standard Crank Pin Gauge.

CRANK PINS will become bent and wear eccentrically and unevenly in spite of the best care that can be given to them. When bent or unevenly worn they must be trued up by turning or grinding, and it is cheaper, and for several reasons better, to true them up without taking them out of the wheels. It is not a simple matter to determine whether a crank pin is slightly bent or not. Of course, bending causes heating, and a hot crank pin generally gives rise to a suspicion that the pin is bent a little. To determine whether a pin is straight and if it has worn on all sides alike, the gauge shown in the cut, taken from the "Railroad Gazette," has been devised.

It is used as follows:—Mount the gauge on the crank pin as shown in cut, and set up the testing screw A until it touches the face of the crank-pin hub. Then revolve the gauge around the journal of the crank pin, and watch the point of the testing screw; if it touches the face of the pin hub all around, the pin is at right angles. If it is off at one place on face of hub and touches it at another, the pin is bent. To determine if

the journal of the crank pin is round and true with the centre of the crank pin, mount the gauge as shown in the cut, and adjust the straight point of needle B to the rim of the outer collar of the crank pin, until it touches the surface of the collar. Then revolve the gauge around on the crank pin, watching the point of the needle; if it touches the surface of the collar all around, the journal is round and true with the centre of the crank pin; but if the needle touches the surface in places and shows open in other places, the journal is eccentric. To measure the eccentricity, describe a concentric circle on the end of the pin, mount the gauge on the crank pin, as shown in the cut, set the bent end C of the needle B on the circle, and revolve the gauge around on the journal of the crank pin; the amount of eccentricity of the journal of the pin will be described on the outer end of the crank pin. This device is manufactured by M. C. Hammett, Troy, N.Y.

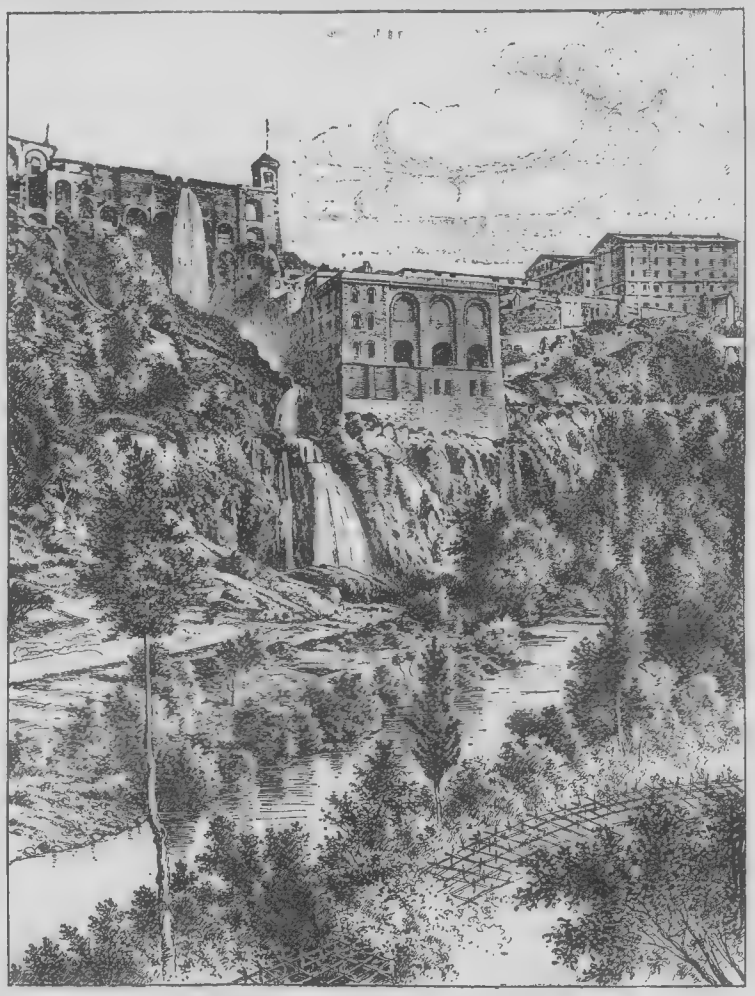
Employment in the Engineering Trades.

THE returns issued for the past month by the Amalgamated Society of Engineers—the principal trade union connected with the engineering industry—are not at all of a satisfactory character as regards the condition of employment throughout the various branches connected with the society. The reports from the various industrial centres throughout the kingdom show a gradual tapering off as regards the amount of work in hand, whilst the returns as to employment show a further considerable increase of out of-work members on the books, these now numbering quite 6½ per cent. of the total membership of the society in receipt of donation benefit. In the Manchester district the number of unemployed members is perhaps larger than it has been for a considerable time past, and a further indication of the unsatisfactory condition of trade is afforded by the much more general suspensions of workmen during the recent holiday stoppages, and the continuance of these stoppages over longer periods than usual. The report of the Steam Engine Makers' Society, which was completed up to the 15th inst., is, however, of a more satisfactory character as compared with the larger organisation, and shows the condition of employment in the Steam Engine Makers' Society to remain practically unchanged, any increase of out-of-work members being so slight as to have no appreciable effect, and the number on the books in receipt of out-of-work support remains at about 2½ per cent. of the total membership. By far the largest proportion of out-of-work members is returned from the marine centres, and in the principal Lancashire inland districts the position is reported as fairly satisfactory, not more than 1½ per cent. of the Manchester membership being at present in receipt of out-of-work support. Wages questions are occupying attention in one or two shipbuilding districts, where reductions are being put in force; but so far as Lancashire is concerned there is at present no movement in this direction.

MEM. FOR ADVERTISERS.—The charges for advertisements in THE MECHANICAL WORLD are less than half those of any other engineering journal in proportion to circulation, and not one-eighth the price of some of its competitors.

The Tivoli to Rome Electrical Transmission Plant.

WE have on previous occasions referred to this long-distance transmission plant, which is now in successful operation, and by means of which a current of electricity generated at Tivoli is used for arc and incandescent lighting in Rome, some 17 miles distant. The plant was erected by the Roman Gas Company as a supplementary source of electricity to the central station at Rome. This company has been operating its station at Rome for six years, the power being furnished by steam engines having a total capacity of 2700H.P. This plant, together with the new station now in operation at Tivoli, is expected to supply the city of Rome with electric lights for public and private use, and with electric power wherever it is required for industrial purposes.



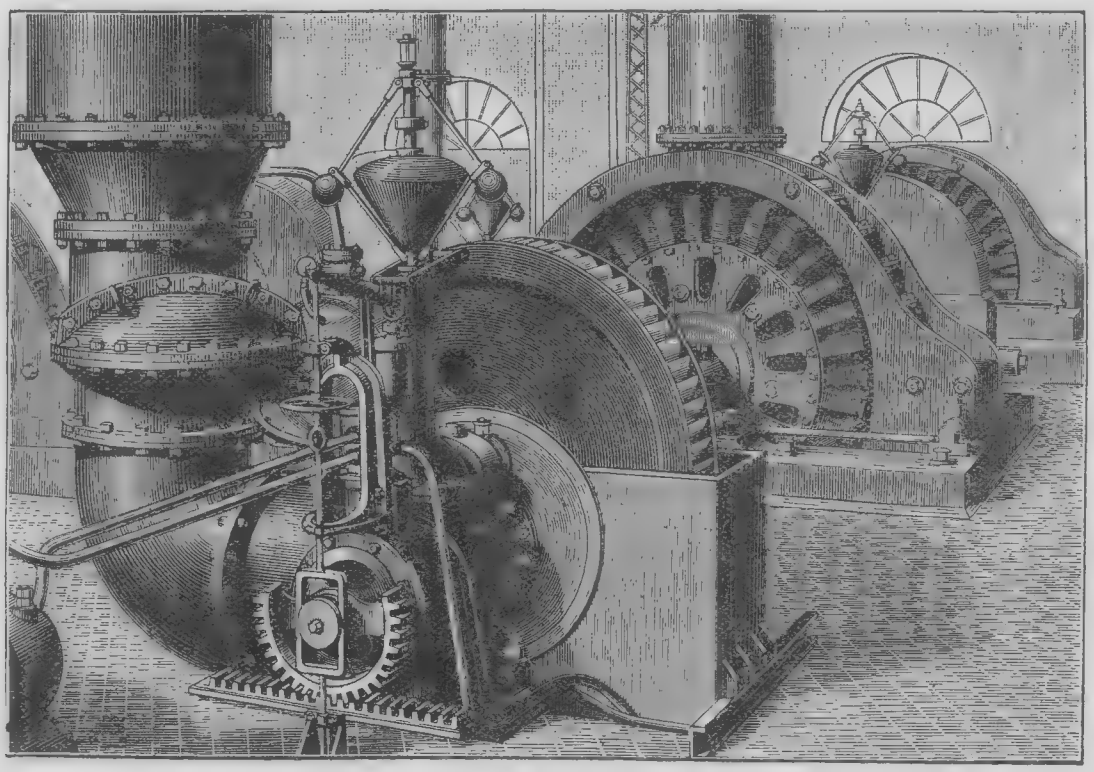
ELECTRICAL TRANSMISSION PLANT.—FIG. 1.

The cataracts of Tivoli have long been utilised as sources of power for various industrial enterprises; but we believe that it was not until 1887 that an electric generating plant was established there. This is still in operation, supplying Tivoli with electric lights on the alternate-current principle, with transformers in series.

Some years ago a company was organised for the purpose of utilising the water power of the falls at Tivoli for the generation of electricity to be transmitted to Rome, but for various reasons the project was never completed. In 1888 the director of the Roman Gasworks, Mr. C. Panchain, took the matter in hand, and to him belongs the credit for having carried the enterprise to its present successful completion. The old and incomplete plant was purchased and the construction of the new station undertaken. This station is erected on the site of the old villa Mecenate, where a waterfall of 3¾ cubic metres per second, 110 metres in height, furnishes the necessary power. The water is carried through a canal on an old Roman viaduct to the wheelhouse. The canal terminates in a tower in which there is a stand pipe of sheet iron 125ft. high and 50ft. in diameter; from the bottom end of the stand pipe a sheet-iron pipe of the same width projects 150ft. farther on and carries water to the level of the ceiling of the wheelhouse. The station stands half-way up the side of a mountain, as shown in Fig. 1. The main room in which the dynamos and turbines are placed is 80 × 50ft. The main pipe for conveying the water into the machine room is divided into three cross pipes, from each of which three vertical pipes lead out. These nine vertical pipes conduct the water to nine turbines (Fig. 3). A complete system of valves, which can be regulated by hydraulic pressure from the machine room, makes it possible to close each of the three cross pipes whenever necessary within a very few seconds. Corresponding with the three sets of pipes are nine turbines, which form three groups, each consisting of two 300H.P. turbines and one 50H.P. turbine. Each turbine is coupled direct to its corresponding dynamo. The turbines are of the Girard type, the 300H.P. wheels having six inlets and valves, and the 50H.P. wheel having one inlet and a throttle valve. The former are constructed for 170 and the latter for 370 revolutions per minute. Each turbine is provided with a self-acting regulator of the Ganz system, which, by regulating the water supply, keeps the speed as accurately constant as is the case with the best types of steam engines. The turbines are completely enclosed in protecting cases, the water outlet being subterranean. In Fig. 2 one of the wheels is shown with the protecting cover removed. Every precaution has been taken to keep the machine room dry.

Each of the larger turbines drives an alternating-current machine, which, at 170 revolutions per minute, supplies a current of 42 ampères, at a potential of 5100 volts. The armature of each of these machines is 2·2 metres in diameter, and each generator has 30 poles. Each of the smaller turbines is coupled direct to a 4-pole exciter, running at 375 revolutions per minute, and furnishing a current of 150 ampères at 180 volts electromotive force. Both the exciters and the large alternators are arranged in parallel. The exciters have hand rheostats. The regulation is effected by two automatic rheostats of the Bláthy type in the field circuit of the exciting machines. These are so arranged that the electromotive force of the alternating currents is kept constant at the distributing station in Rome. The breaking of the circuit is effected by means of a dead resistance of iron wire.

The conductors from Tivoli to Rome are carried through the deserted Campagna Romana for a distance of nearly 17 miles. The leads consist of four copper cables of 19 wires each, the entire system of conductors containing 100 tons of copper. These cables are so arranged that they can be exchanged at will in case of accidents or when repairs are necessary. Of the existing four cables three are sufficient for running the entire plant, while two are sufficient for two-thirds of the load. The loss in transmission amounts to 20 per cent. of the total pressure—that is, 1020 volts, the initial pressure being 5100 volts.

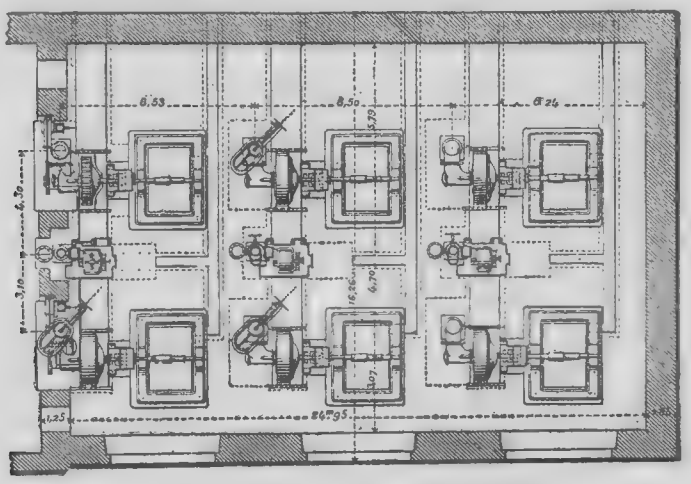


ELECTRICAL TRANSMISSION PLANT.—FIG. 2.

The cables are attached to very strong oil insulators placed upon poles or iron columns set from 115 to 130ft. apart. These poles consist of two parallel T-irons connected together by bolts, at the upper end of which are wooden uprights 10ft. in

length, to which the oil insulators are fastened. The same line of poles carries silicon bronze wires for telegraph and telephone purposes, the lowest wire being 25ft. above the ground.

The conductors from Tivoli terminate at the old Roman wall near the Porta Pia, in a small building, where the necessary transformers and other apparatus are placed. As the central station in Rome is operated at a pressure of 2000 volts, and as the Tivoli plant, as stated above, is intended as a supplementary station for the plant in Rome, the current from the Tivoli station must necessarily be reduced from 4000 to 2000 volts. For this purpose 32 transformers, each of 25,000 watts capacity, are placed in the transformer building. Of these 32 transformers, 16



Electrical Transmission Plant.—Fig. 13.

arranged in parallel form a group which transforms the 4000-volt current into a current at 2000 volts, and transfers the current from the Tivoli aërial conductors to the underground network of concentric cables that distribute it over the streets of Rome. In the summer, when the demand is at a minimum, and also during the daytime at other seasons of the year, it is intended to operate entirely from the Tivoli plant, and to make use of the Rome central station only when greater demand makes it necessary.

At present 250 arc lights are in use, but this number can be increased at any time up to 600. These lights are in series of 45 each, and have aërial lines of copper wire four millimetres in diameter. Each of the large transformers in the transformer house is able to furnish 14 ampères at 2000 volts for supplying 45 arc lamps; 14 such transformers are able to feed the 14 arc light circuits, or over 600 lamps, the other two transformers being kept in reserve. In each of these circuits an automatic rheostat keeps the intensity of the current constant at 14 ampères.

Process of Rendering Iron or Steel Homogeneous.

The process of magnetisation of a piece of iron or steel is well known to consist in or relate to some arrangement of part or all of the iron molecules with their axes in a certain relation to the magnetic axis of the piece. In a piece of soft iron the molecules return to their former condition immediately on the withdrawal of the magnetic influence, while a reversal of the polarity produces a rotation of the molecule, changing the direction of its axis by 180 degrees. The frequent reversal of the polarity of a piece of iron causes a humming sound, due to the rapid and concerted movement of the molecules. It is well known that a stirring up or other agitation of a metal when still fluid or settling down to a definite structure, crystalline or otherwise, tends to produce a uniformity in the casting not otherwise to be secured.

Now, although it is readily proved by experiment that a fluid or semi-fluid magnetic metal is not susceptible to magnetic influence, the inventor and patentee of the process of which this article treats—Mr. Joseph C. Fraley—believes that the molecular movement mentioned above as existing in a cold piece of iron or other magnetic metal in a magnetic field, the polarity of which is rapidly reversed, exists likewise if the metal be in a fluid or semi-fluid condition, and he therefore holds that such an influence will produce a homogeneous quality in the casting or ingot which would not otherwise be secured. The plan of subjecting a casting while cooling to a uniform magnetic field has been already proposed, but, so far as we are aware, this process has not secured any noteworthy results.

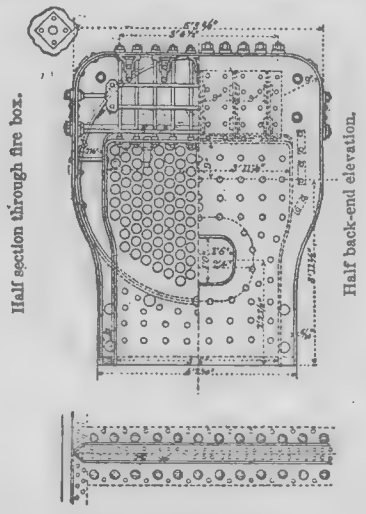
Mr. Fraley's patent claim covers the "process of rendering iron, steel and similar metals homogeneous, which consists in exposing the metal while in a heated condition within a magnetic field and repeatedly varying such magnetic field during the cooling of the exposed metal." In the case of a casting the metal is poured into a mould which contains a coil of insulated wire so placed that it shall surround the metal. A rapidly alternating current is then made to circulate in the coil until the casting has solidified. A modification of this process is applicable to the case of a piece of metal raised to a temperature below its melting point, as in ordinary annealing. A further advantage claimed for the process by the inventor is the removal of foreign substances from the mass of the casting.—"American Manufacturer."

At the ironworks of Messrs. Metz and Co., at Esch-sur-l'Alzette, the centre of the Luxemburg iron district, the foundations of chimneys, stoves, and even blast furnaces are made of slag. First a rough tower is built of old fire-blocks to the level required; and then the slag is allowed to flow from the furnace directly into the tower until completely filled. This practice has been found to answer admirably, while being very economical; but it is probable that a substance so liable to disintegration as blast-furnace slag would not answer as a foundation.

The Construction and Efficiency of Boilers of Locomotive Engines.

(*Concluded from page* 108.)

Comparing English and American boilers it will be observed that the ratio of grate area to cylinder capacity is nearly twice as high in the American examples, due, doubtless, in some degree, to the quality of the fuel used. In English practice the improvements of the past ten years have been confined almost entirely to express engines. An average goods engine boiler



Locomotive Boilers.—Fig. 13.

consumes 45lb. of fuel per train mile, without showing any extra evaporative efficiency over an express engine with a consumption of from 25lb. to 30lb. of fuel per train mile. The goods engine boiler is not supplied with adequate grate area, consequently to make the boiler do its work and produce steam uniformly, heavy and deep firing is necessary, resulting in incomplete combustion and waste of fuel. When it is borne in mind that about 45 per cent. of the total heat of the furnace is radiated into the water surrounding the firebox, arguments proving the advantages of large grate areas are unnecessary. American locomotive boilers, as a rule, have shallow fireboxes and large water spaces, details of construction which add considerably to their evaporative efficiency. It has been proved by experiment that the flat and deep sides of fireboxes, due to the narrow water space and restricted circulation, pass off steam very sluggishly. This objection to English locomotive boilers may, to a certain extent, be overcome by a liberal allowance of water space between the firebox and the shell, and by pitching the centre line of the boiler higher above the engine frames and reducing the depth of the firebox.

It would be impossible to establish any fixed rule for the proportion of grate area to capacity, owing to the variation of the calorific value of different kinds of coal. The author is of opinion that a fair proportion would be 1sq. in. of grate area to 4 cubic in. of cylinder capacity; but this rule must vary with the size of the cylinders—that is to say, if the cylinders are upwards of 16in. in diameter, the rule may hold good; but if below that diameter a large firegrate would not be economical, inasmuch as engines with cylinders of less than 16in. in diameter are generally employed for shunting purposes, and are not required to maintain a uniform steam pressure.

Another example of American practice is a boiler designed by Mr. T. N. Ely, M. Inst. C.E., for freight engines on the Pennsylvania Railway (Fig. 12). The boiler barrel, which is telescopic and made of steel, is built in three rings $\frac{7}{16}$in. thick, the mean diameter being 5ft. $\frac{7}{8}$in. The longitudinal seams are covered with inner and outer butt strips, which are single riveted on each side of the joint. The boiler is stayed longitudinally with 1$\frac{1}{8}$in. gusset stays. The firebox shell (Fig. 13), which is of the Belpaire type, is flat on the top, and stayed transversely with 37 1$\frac{1}{8}$in. stays, which are screwed through each side of the box and attached to internal cross-pieces, with nuts and washers on each end. The shell covering sheet is made of three plates $\frac{7}{8}$in. thick, and the seams are covered with inner and outer butt strips, which are single riveted on each side of the joint. The firebox covering sheet, which is made of $\frac{7}{16}$in. steel plates, is attached to the shell by 190 stays 1in. in diameter; the ends of these stays are screwed through the shell, and are fixed at the upper ends with nuts and washers. The lower ends of the stays have solid washers turned on them for holding the under side of the firebox covering sheet. The ratios obtaining in this example are:—3·35 cubic in. of cylinder capacity to 1sq. in. of grate area, 1 cubic in. of cylinder capacity to 14·94sq. in. of tube-heating surface, and 1 cubic in. of cylinder capacity to 16·52sq in. of total heating surface.

In conclusion, the author begs to acknowledge his indebtedness to the following gentlemen, who have placed at his disposal drawings and information in connection with the boilers of locomotives under their charge:—Mr. Wilson Worsdell, Assoc. M. Inst. C.E., of the North-Eastern Railway; Mr. James Holden, M. Inst. C.E, of the Great Eastern Railway; Mr. T. N. Ely, M. Inst. C.E., of the Pennsylvania Railway, U.S.A.; Messrs. Burnham, Parry, Williams and Co., of Philadelphia, U.S.A.; and Messrs. John Brown and Co., of Sheffield.

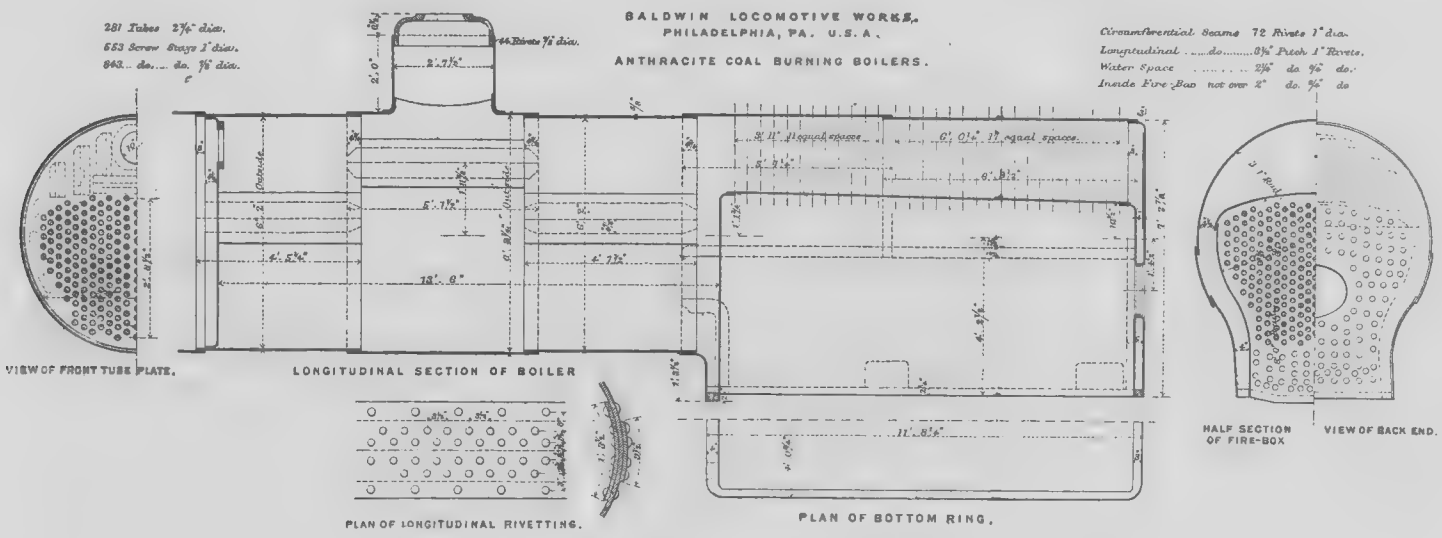
The Utilisation of the Energy of Flowing Water.

(*Concluded from page* 111.)

The results of the experiments were encouraging, for, although the actual efficiency was low, it was at least as high as that of any other current motor, while it had been demonstrated that a machine could be contrived, water borne throughout, to absorb the energy of a much larger sectional area of stream than had ever been before attempted, and on a principle capable of easy extension to great size. The machinery had worked smoothly throughout the tests, and considerable experience had been gained as to the behaviour of water acting upon completely submerged paddles in an open stream.

It was evident that the friction of the chain and gearing was excessive, and could certainly be reduced, and there was every reason to expect that a motor could be designed having the advantages of this machine, but with such improvements in the vanes and reduction in friction as to give an actual efficiency of 25 per cent.

The efficiency, however, of such a motor is only important in so far as it affects the cost of production of a horse-power, because, unlike the case of the



Locomotive Boilers.—Fig. 12.

other machines working under a definite head, where efficiency is all-important, there is here no competitor.

The authors, therefore, having the great advantage of the advice and friendly criticism of Prof. Unwin, designed a new motor — plan, section, and elevation of which are exhibited. This machine is of much simpler construction than that before described, and differs from it widely in detail, but not in the essential principles before stated.

This motor, when at work, is moored at right angles to the direction of the current, so that, in proportion to its length, the greatest possible sectional area of stream is dealt with.

The machinery is carried on a single pontoon, underneath which a lower deck or platform is firmly attached, and while protecting those moving parts which are submerged from damage, it allows of the motor taking the ground, and even being worked in that condition.

The blades are fixed at even intervals to an endless chain passing over and gearing with two vertical end wheels, instead of rolling round a rail track, so that the great weight and friction of the wheel carriages are avoided, and the gearing is immensely simplified.

The bearings for the wheel shafts are placed at such a level on the pontoon that half the chain and blades are submerged in the water, while the other half are suspended in the air. To keep the chain straight in the water and to resist side pressure, fixed guiding rollers are provided at short intervals.

The back portion of the pontoon is constructed with a water-tight deck interposed between the wheels and the two parts of the chain, so that, when the current imparts motion to the chain, those blades which are submerged have a clear passage between the lower platform and the pontoon, and are free to return in the air above.

The remaining portion of the pontoon is open, and carries the gearing and machinery to be driven.

The ends of the pontoon are boarded up outside the wheels carrying the chain, to permit of the motor being towed without damage to the blades.

The space between the pontoon and the lower platform, through which the current has to pass from the front of the motor to the blades at the back, is in the form of a bell mouth, contracted laterally by means of a curved wing vane at each end, and vertically by the inclination of the bottom of the pontoon and the lower platform.

In this space the current is diverted into the line of action of the blades, which is at right angles to the stream, by means of curved guide vanes, and the blades are also curved to receive the pressure of the water, and allow of its free escape into the stream beyond.

The whole arrangement is, in fact, designed approximately on the principle of the turbine.

The object of the bell mouth is to concentrate the energy of the large sectional area of stream entering the machine on to a comparatively small blade area, and at a higher velocity than the natural flow of the current, the advantage being the further reduction of the weight and consequent friction of the moving chain and blades, and the increase of initial speed of the driving wheels with corresponding lessening of weight and friction of the gearing.

One of the end wheels is provided with spur gearing revolving a second motion shaft, from which any higher speed for driving machinery is obtained by belts and pulleys.

The shaft of the other end wheel revolves in bearings which are set in a guide frame, and can be adjusted by screws to take up wear or slackness in the chain.

In a tidal current the motor would be allowed to swing at slack water in the ordinary way, and be hauled into position for the next tide. In the case of rivers, of course, no change of mooring will be required.

TABLE B.

Sectional area, 151·6sq. ft.

Velocity of stream.		H.P. of stream.	H.P. of a machine at 25 per cent. efficiency.
In miles per hour.	Feet per second.		
1	1·467	0·34	—
2	2·933	6·74	1·68
3	4·4	22·75	5·68
4	5·867	53·94	13·48
5	7·333	105·29	26·32
6	8·8	182·02	45·50

Table B has been prepared to show the power of a motor of this construction, taking the efficiency at 25 per cent. The sectional area at the bell mouth is 151·6sq. ft., or equal to that of the experimental machine. For a bell mouth of this area, 4ft. deep, a pontoon 40ft. long by 11ft. wide would be sufficient; but this must not be taken as indicating the limit of size or even the most economical proportions of the machine.

From the figures in the table, a simple proportion will give the area at the bell mouth for any required power.

For example, if 40H.P. is required from a stream of four miles per hour: 151·6sq. ft. is to the area required as 13·48 is to 40 or 450sq. ft.

Such a machine would require a pontoon 75ft. long and 6ft. deep at the bell mouth, and would be no larger than an ordinary barge moored in an estuary.

It is clear from Table B that the cost per horse-power must depend almost entirely upon the velocity of the current, as the capital, outlay, maintenance, etc., is, within wide limits, nearly constant.

It is estimated that a machine 40ft. long, as above, can be constructed for £300.

In a moderate stream of three miles per hour it is expected that it will develop at least 5H.P.

Taking interest, maintenance, and depreciation at 12½ per cent., the annual cost per horse-power would be £7 10s., leaving out the cost of attendance, which, however, in hydraulic machinery is very low.

There are no steam engines of small power, even in this country, where coal is not dear, which work at anything like so small a cost. In cases such as pumping, where the work could go on night and day, the annual cost of the steam horse-power would be more than doubled; but the cost of the hydraulic motor would not be increased.

If considerable power is required, several motors can be arranged in series at near intervals.

The authors are convinced that there is a large field for the employment of this motor. It is eminently suitable for pumping water for irrigation, the charging of accumulators, and other purposes, and for the storage of electricity in secondary batteries for the many uses for which these are employed. It has the advantage of being easily moved from point to point on a stream, for its temporary hire for agricultural and other work, where permanent power is not required.

A useful application would be to construct the machine in connection with the pontoons of floating bridges, where these exist, which could be done at small cost, and the sale of power made to assist the revenue derived from tolls. Such revenue, when added to the tolls, might even permit of the construction of these bridges in places where the traffic estimate would not otherwise justify the capital outlay.

Favourable places for the employment of the motor, both in this country and abroad, will at once occur to many members of the association. Wherever the floating mill is now used, the suitability is undoubted—as the Rhine, Danube, Douro, and others. To these may be added the great rivers of North and South America, Africa, and India; tidal estuaries, as at Liverpool, Plymouth, Portsmouth, Hull, and many more; and channels, such as the Menai Straits, where it was lately said by Mr. W. H. Preece, F.R.S., in an interesting lecture upon "The Waste Forces of Nature," there was a power of 6000 horses, if only it could be used.

In conclusion, the authors do not claim to have done more than touch the fringe of the question of converting the great tidal energy around us into useful work. They venture to hope, however, that they have indicated a means whereby the energy of flowing water may be effectually used without the erection of permanent works, even in currents of moderate velocity, and that a large field exists for its profitable employment.

Metal Trade Memoranda.

Messrs. J. Lysaght Limited, Wolverhampton, are erecting four new mills at their Osier Bed Works.

Mr. A. V. Bright, late of Kidwelly, South Wales, has erected a tinplate works at Magona, Italy.

At the works of the Barrow Hematite Steel Company there are now only two mills at work—the rail mill and the tinplate bar mill.

Messrs. Walker, Maynard and Co., at the Redcar Ironworks, have blown in their third furnace, and now have only one idle. The Clay-lane Iron Company have blown out a furnace.

A very extensive contract has just come into the market for cast-iron water pipes for Calcutta; 13,500yds. of 4in. pipes, 18,000yds. of 3in., and 1000yds. of 2in. pipes are wanted. As the Glasgow pipefounders are rapidly running through their contracts, the competition for this contract will be keen.

A month's notice to terminate contracts has been served upon the workmen engaged at the Gravesend Tinplate Works and Messrs. William Lewis and Sons' tinplate works at Gorseinon, and at the expiration of that time contracts will run from week to week only. The notices affect 600 or 700 men and 11 mills.

On the 13th inst., at Middlesbrough, the Lackenby Ironworks, consisting of three blast furnaces fitted with Cowper stoves, were offered for sale by auction as a going concern. Mr. Illtyd Williams, of the Linthorpe Ironworks, Middlesbrough, made the only bid—£25,000,—and the lot was withdrawn.

Louventhal's method of separating tin from cadmium, which is the one commonly used, consists in oxidising the stannous chloride in solution by heating it with a mixture of sodium sulphate and ammonium nitrate. This method of separation requires considerable care, for the oxide of tin precipitated is gelatinous, and is consequently hard to collect and thoroughly wash. Mr. French, by using peroxide of hydrogen as the oxidising agent, finds that the oxide of tin obtained separates readily from the solution and is easy to wash. The peroxide is added to a nearly neutral solution, to which heat is then applied. The cadmium remains in the filtrate, from which it can be precipitated by sodium or potassium carbonate.

The platinum beds of the Ural Mountains are the only ones in the world in which this metal is found in grains. Platinum is found in Brazil and in the Cordilleras in the hard serpentine rocks, but never in the form of grains. The platinum beds of the Ural Mountains are found in various districts—in the North, at Besserski, in the Government of Perm, in the district of Khotourski, and in the State properties of Goroblagodatski, where sixty-six mining concessions have been granted. All the beds of the northern region are situated in the basin of the river Touri, in that of the tributary stream of Taghil, and in other tributaries higher up. On the western declivity of the Ural Mountains there is another platinum bed near the river Outka, a tributary of the Tchoussova, and the basins of the higher tributaries of the Outka, near the Ural River. The platinum found in these places is in the form of grains, in sand frequently containing gold. The weight of these grains is from 17 to 21 grammes to every 1640 kilogrammes of sand.

The Metal Market.

PRICES CURRENT.

LONDON, September 19.

COPPER opened with £44 bid for cash, but business immediately followed at £44 1s. 3d., and three months was done at £44 10s., there being few sellers at these values. The lower prices were mainly induced by the unfavourable figures published on Friday last, there being scarcely any demand from consumers. It is reported that 100 tons of rich Columbian matte have been sold at 9s. 1½d. per unit. At the afternoon session there was little desire shown to do business, previous bids were repeated, and a small cash trade was done at £44 1s. 3d., closing values showing a loss of 1s. 3d. on the day. Among others, October 5 brought £44 2s. 6d.; December 16, £44 8s. 9d.; and November 17, £44 5s. Sales, 300 tons. Settlement price, £44. English tough, £47 5s.; best selected, £48 5s.; strong sheets, £55.

TIN began very quietly, £92 2s. 6d. being paid for cash, and £92 5s. for three months warrants, but this was all the business done. In the afternoon the market ruled dull and 2s. 6d. easier, £92 being accepted for cash. Sales, 10 tons. Settlement price, £92. For two tons Banca £93 was bid and refused. English ingots, £95 to £95 10s.

PIG IRON has been very idle all day. At the opening, 41s. 6d. was bid for cash, 41s. 8d. for one month, and 42s. for three months open, but no business resulted. At the closing session 41s. 5d. was bid for cash, but nothing was done, and final values are 1d. lower for Scotch, and 6d. for hematite. Settlement prices:—Scotch, 41s. 6d.; Middlesbrough, 40s.; hematite, 49s. 6d.

TINPLATES are very quiet, and there is no inquiry for America. I. C. cokes unchanged: f.o.b. London, 12s. 9d.; Liverpool, 12s. 3d.; Swansea, 11s. 9d.

LEAD is steady, with buyers of English at £10 5s.; and Spanish is 1s. 3d. dearer at £10 3s. 9d., buyers.

SPELTER is practically nominal. September shipment is quoted at £17 15s. to £18, but no business has transpired. Continental advices deny that the international syndicate has dissolved, but state that, while discontinuing the agreement regarding prices, they have decided to reduce the production by 5 per cent. for one year, commencing 1st prox. Silesian specials, £18 10s.

ZINC.—Belgian quiet, and 7s. 6d. to 10s. easier. V.M. brands, f.o.b. Antwerp, £22 5s.; ex ship here, £22 10s. Silesian ordinary brands have given way another 10s. to £21 15s., ex ship.

OFFICIAL CLOSING QUOTATIONS.

	£	s.	d.	£	s.	d.
COPPER—						
G. M. B.—Cash	44	1	3	44	18	9
" Three months	44	12	6	44	17	6
English tough	—	—		—		
Best selected	—	—		—		
Strong sheets	—	—		—		
TIN—						
Fine foreign—Cash	92	0	0	92	10	0
" Three months	92	5	0	92	15	0
Australian—Cash	92	10	0	93	0	0
PIG IRON—					s.	d.
Scotch warrants - Cash					41	6
" One month					41	8½
Middlesbrough—Cash					40	0
" One month					—	
Hematite—Cash					49	6
" One month					—	

GLASGOW, Sept 19.—On the pig-iron market the business was almost wholly of a jobbing or forfeit character, which is not a satisfactory class of business. The tone for Scotch, owing to reports of extreme depression in Clyde shipbuilding (15,000 men being said to be idle), was flat, and sales took place at 2½d. below Friday's close. Cleveland was marked down 1d., and hematite 6d. One lot hematite sold at 48s., with delivery at any time during the year in seller's option. Shipments of Scotch last week, 7557 tons, being a decrease of 266 tons on the corresponding week, and reducing the increase to date to 30,031 tons.

QUOTATIONS.

	Highest.		Lowest.	
	s.	d.	s.	d.
Scotch warrants—Cash	41	7½	41	5
" One month	41	9½	41	8
Middlesbrough—Cash	40	0	40	0
" One month	—		—	
Hematite—Cash	49	3	49	3
" One month	—		—	

Official Gazette.

THE BANKRUPTCY ACTS, 1883 AND 1890.

Receiving Order.

C. LITCHFIELD, Wellingborough, engineer and machinist.

Adjudications.

C. LITCHFIELD, Wellingborough, engineer and machinist.

A. G. HAMILTON, Argyll-place, Regent-street, W., and Ridgmount Gardens, London, W.C., mechanical engineer.

Trade Marks.

The following is the Official List of Applications published from September 7 to September 14, for the Registration of Trade Marks, so far as relates to the Metal Trades.

CLASS 5.

TGE

166,196. Iron and steel. AKTIEBOLAGET FINSPONGS STYCKEBRUK, Finspong, Sweden; iron and cannon manufacturers.—26th July, 1892. Mark used since 1856. Address for service in the United Kingdom, c/o The Trade Mark Owners' Mutual Protection Association Limited, 17—18, Basinghall-street, London.

New Companies.

GLOBE ENGINEERING COMPANY LIMITED.—This company was registered on the 14th inst., with a capital of £40,000, in £5 shares, to carry into effect an agreement expressed to be made between Mr. A. G. Brown, of the one part, and this company, of the other part, for the acquisition of the undertaking of ironfounders, iron and steel manufacturers, engineers—mechanical and electrical,—tool makers; to acquire patents and inventions of every description, and to develop and turn to account the same.

BARTON-WRIGHT LIMITED.—This company was registered on the 9th inst., with a capital of £16,000, in £1 shares, to adopt and carry into effect, either with or without modification, an agreement dated September 26, and made between Mr. E. W. Barton-Wright, of the first part, Mr. J. Woolford, of the second part, and Mr. J. J. Chadwick (for the company), of the third part, and to carry on the business of smelting antimony ores (other than such antimony ores as contain gold or silver to the extent of 2dwt. or upwards to the ton of ore), and manufacturing oxide of antimony from such ores (other than as aforesaid), and purchasing and procuring of oxide of antimony, and converting into star metal the oxide so manufactured, etc.

Prize Competition.

WE OFFER FOUR GUINEAS MONTHLY IN PRIZES FOR THE BEST ORIGINAL ARTICLES SENT IN ON ANY MECHANICAL, ENGINEERING OR ELECTRICAL SUBJECT.

IN ORDER THAT MANAGERS, DRAUGHTSMEN, FOREMEN, AND WORKMEN WHO HAVE HAD NO PRACTICE IN WRITING MAY NOT HESITATE TO SEND IN COMPETITIONS, IT IS TO BE UNDERSTOOD THAT ALL ARTICLES WILL BE FULLY EDITED AND CORRECTED, AND JUDGED OF SOLELY ON THEIR MERITS AS ORIGINAL CONTRIBUTIONS FROM A PRACTICAL POINT OF VIEW. THE OBJECT OF THE COMPETITION IS TO INDUCE PRACTICAL MEN TO COME FORWARD AND GIVE THE RESULTS OF THEIR EXPERIENCE.

CONDITIONS.

Competitions for our Monthly Prizes must be sent so as to arrive at the Manchester Offices of THE MECHANICAL WORLD, New Bridge-street, not later than the last Tuesday in each month. Articles arriving after that time will be placed in the following month's competition.

Written competitions must be on one side of the paper only. The contributions must be original, and relate to matters connected with Engineering, Mechanism or Electricity.

The Proprietors of THE MECHANICAL WORLD reserve the right to publish any competition, whether it gains a prize or not.

The competitions may be accompanied by diagrams, sketches or drawings.

Competitors should write the words "Prize Competition" on the envelopes.

Competitors are not confined to one, but may send any number of competitions.

The correct name and address of the sender *must* be distinctly written upon every competition, not necessarily for publication. Competitions can appear under a *nom de plume*.

☞ We cannot undertake to be responsible for any MSS. sent to us, though when stamps are enclosed for the purpose we will endeavour to return rejected contributions.

Letters to the Editor.

*** *We do not hold ourselves responsible for opinions expressed by correspondents.*

*** *The name and address of the writer (not necessarily for publication) must in all cases accompany letters intended for insertion, or containing queries.*

*** *Letters intended for publication in the current week's issue must reach our Manchester Office not later than by the first post on the Tuesday preceding the date of publication.*

CONSTRUCTION AND EFFICIENCY OF LOCOMOTIVE BOILERS.

To the Editor of THE MECHANICAL WORLD.

SIR,—I have followed with interest the paper by Mr. G. Harrison on the above subject, and, while agreeing with him in many particulars, there are many points of detail in which we differ very considerably. Considered as a grouping together of the good points in the practice of several well-known engineers, the paper is valuable; but as a record of what is done by commercial locomotive builders and engineers it is useless. The loco. superintendent of a railway has his fads and fancies, and can often carry them out unrestrained, while the loco. engineer who takes his work to the open market must make an engine at a reasonable cost to give good results from some one else's working.

The essayist's description of the longitudinal lap joint of a loco. boiler barrel is certainly incorrect except in a very few cases indeed, while his description and explanation of the cause of grooving are, according to my experience, quite erroneous. There is not "a condition of slight tension" due to setting the plates, nor yet is there a "vertical expansion and contraction of the barrel." What takes place is as follows:—Owing to the varying temperature of the boiler from rest to the working pressure, there is a *general* expansion and contraction of all parts; but what here affects us is the circumferential expansion and contraction, which is aggravated by the varying pressure tending to strain the shell into a true circle (which during construction is practically impossible), thus causing a hinging action at the very edge of the underlap; and in the hundreds of cases I have seen they have invariably been at the edge, and not ¼in. away, and in many instances they have actually been under the underlap, and quite invisible until cut asunder, the grooving often penetrating half-way through the plate, and being as fine as a line—in every way resembling a fracture.

Mr. Harrison's objections to the use of angles, as shown in his Fig. 1, do not altogether hold good. If only one or two boilers are to be made, the use of angles neither increases cost nor weakens the boiler. Certainly a well-blocked plate is best, but if special blocks are to be made for one or two boilers, what will be the increased cost? He also seems to lose sight of the fact that a high firebox shell does not necessarily mean a high firebox crown and "erroneous water level," but it certainly does mean a slightly increased steam reserve without sacrificing anything; and the move made was not to reduce the size of the firebox shell to that of the barrel, but to increase the diameter of the barrel to that of the firebox shell, giving a simpler structure to build.

He refers to the weldless hoops being shrunk on. This I consider good practice, but would call attention to the evil that may be wrought if these hoops or belts are shrunk on too tightly. The shrinking should not be too tight or the belts too rigid, or circumferential grooving will set in, as I have many times seen—perhaps not to a serious extent, but still it has been there. The shrinking should only be sufficient to draw the belt and plates together. Again, the local heating of the edges of steel plates is objectionable, so that weldless steel hoops and belts are not faultless. If Mr. Harrison will consider the great difference in conditions to be met with on different lines, he will not think the difference in practice as to grate area, cylinder capacity and heating surface so "strange," not to mention the very varying qualities of fuel to be consumed—for instance, best Welsh coal on level roads and Yorkshire bituminous coal on heavy gradients.

In speaking of roof-bar stays and their slings to the crown, he says these "slung stays bear no load in ordinary working conditions." Is this really so? My experience is that such a condition is only existent during the limited time occupied in raising steam, or when the fires are unduly urged. Once the fires are well going, and steam is at its maximum pressure, the slings are just holding tight, or should be if properly arranged. With regard to the "tap bolts" in the roof bars, is there not a great difficulty in getting a continuous thread? It is perhaps not the modern, but it is still good practice to screw the bolts into the firebox crown plate, allowing them to pass freely through the roof bar and secure with a nut on the top of the roof bar, the bar being formed as would be the case as described in the paper, thus protecting the bolt from corrosion. With roof bars, or rather girder stays, there is always the difficulty of circulation and keeping clean. With the direct-screwed stays, as in the Belpaire firebox, and as shown in Mr. Harrison's Fig. 7, the firebox top is more easily kept clean. This, however, is its only recommendation.

With regard to the beading of tube ends, my experience is that beaded tube ends, although they look better, do not generally make so good a job as leaving them well expanded. If badly expanded, then beading will assist in making them tight, but once they become leaky they are more difficult to deal with. In regard to the rivet holes, I quite approve of the service or tack holes, and presume that all are drilled in position, the punching of shell plates before bending being now ancient history.

I am glad to see Mr. Harrison mentions "hollow stays," about which an American engineer had so much to say lately, but I cannot agree with him as to the breaking of screwed stays being "due entirely to the limited water space between shell and firebox." Twenty-five years ago broken stays were very common; now they are a rarity. Still the water spaces are in many cases the same; but we have better methods of drilling and tapping the holes, and this is the chief reason of the improvement. With regard to Mr. Stirling's practice with longitudinal bolts, he is in the right direction. What is wanted is to stiffen and strengthen the flat ends, not to tie both ends together. If large Lancashire boilers 8ft. diameter at 120 to 200lb. pressure are reliable without them, surely a locomotive boiler 18ft. by 4ft. 6in. in diameter need not be fitted with them. With respect to the flanged firehole in place of the solid ring, this is an old device, but was most extensively reintroduced in improved section by Mr. Webb. The grooving is not a serious defect, nor is it a prevalent defect. The burning and fracturing of the overlap with the solid rings is far more troublesome.

I must ask pardon for troubling you so far, and by your kind permission I will say more and ask a few questions when the paper is concluded. RIVET.

Manchester, Sept. 17.

WHAT ELECTRICITY IS.

To the Editor of THE MECHANICAL WORLD.

SIR, — Some authors are given to speaking of electricity as a *thing* which "exists in organic as well as in inorganic bodies." Is it not better to consider electricity not as a thing, but as a *state*, such as a state of equilibrium disturbed and seeking to adjust itself, or a state of tension? When two dissimilar metals are brought into contact, it would seem that a balance is somewhere or other disturbed, and it *may* occur in what is called the ether. Let us assume that all things (including, of course, the air and its composite gases) float and are supported in a medium which we will call the ether, and this elastic medium can, by means which we control (batteries, etc.), be displaced, and that the displacement and reunion give rise to vibrations, which are those phenomena which we name current and electrical pressure.

When we magnetise and demagnetise iron, there is probably a disturbance of equilibrium somewhere, and perhaps it is of the nature of vibrations in the ether which surrounds the particles of the iron, the vibrations being long in proportion to the intensity of magnetism. Are these vibrations the current producers?

We know that vibrations under certain conditions manifest themselves as heat and light, but in our investigations of light we must examine it from the point of view of a vibratory motion, and not by its effects upon the brain produced through the medium of the human eye, giving the sensation of vision, the eye being regarded only as a cunning contrivance for transmitting sensations by means of light vibrations. It is probable that the short vibrations causing light fulfil other functions in bodies, and the causation of vision is only one of such functions.

It is worth while to inquire whether the vibrations set up by combustion are in any way analogous to vibrations set up by magnetism in iron.

One way to set up heat vibrations is by friction; this causes expansion and a liberation and disintegration of the elements of the substance in which the friction occurs, followed by incandescence. We also develop heat vibrations by the effect of magnetism in bodies, and effecting chemical changes in bodies, and the deduction would appear that both heat and light and current are all produced by one and the same means—namely, vibrations of the ether.

The ether theory of Schmitz-Dumont is, that it consists of a system of particles of the same strength, repelling each other in inverse ratio to the square of their distance. This is designated by the symbol $E - \frac{1}{r^2}$.

Bodies (such as dissimilar metals) may be in a different state of potential, and upon contact the "current" set up is the movement of the ether particles which are tending to equalise the pressure (or tension), and this movement is what we term current in our conductors. E. WOODHEAD.

Derby, Sept. 17.

Miscellaneous Items.

The largest graphite works in Sweden were recently opened at Vöstamfors.

The new railway from Jaffa to Jerusalem is completed, the first locomotive entering Jerusalem on the 13th inst.

A blast furnace, weighing 100 tons, belonging to the Hain Works, near Siegen, Germany, was recently bodily raised about 8ft. higher.

A report has been drawn up as regards the electric lighting of Singapore, which estimates that the cost of a suitable installation would amount to £70,000.

The Brest Harbour Board have placed an order for three steam engines with the firm of Weyher and Richemont, of Pantin. They are intended to be used in connection with the electric lighting of Brest Arsenal.

A company has been formed at Copenhagen with the object of building a permanent Eiffel tower in that city. The tower, which will be built of steel and iron, and which will be lighted by electricity, is to be 1670ft. in height.

The French newspapers are testing a novel sort of type, made of malleable glass by a new process. The new types preserve their cleanliness almost indefinitely. They are said to wear better than those made of metal, and can be cast with a sharpness of line that will print more distinctly than is possible with the old style of type.

The construction of the Siberian Railway is being pushed forward with considerable activity, and the hope is entertained that the stretch between Zlatonst and Tcheliabinsu will be opened for traffic in December next. The sleepers and rails are being laid down on that section of the line situated along the Usral river, in the extreme east of Siberia.

The French "Journal Officiel" has published a decree ordering a Universal Exposition of Arts and Manufactures to be opened in Paris, May 5, 1900. It would seem from this announcement that France has decided to have a universal exposition every eleven years, for there was one in 1867, 1878, and 1889. The decree states that the exposition of 1900 will be fully representative of the art and philosophy of the nineteenth century.

It was recently stated that no English firm had plant sufficiently large to roll the rudder plate of the "Campania," which was accordingly obtained from Krupp, of Essen, Germany. Mr. C. J. Stoddart, of the Park Gate Iron and Steel Works, Rotherham, states that from inquiries he has made it appears that this plate was 21ft. long by 11ft. 3in. wide by 1½in. thick, a size which could easily have been rolled and supplied from the works of his firm.

Herr Reinhardt Mannesmann has invented a process for increasing the resistance of aluminium to atmospherical, chemical, or mechanical influences. The inventor says that the addition of a little tungsten to pure aluminium or its alloys communicates a remarkable resistance to the action of cold or hot water, salt water, and other reagents. When the proportion of tungsten is sufficient, the alloys formed offer among other physical properties great resistance to traction and tension. The proportion of tungsten can be varied within extremely wide limits, according to the composition and the nature of the alloy, and according to the usage for which it is destined. The tungsten can be added alloyed with other metals; but the most advantageous way consists in adding the tungsten before the aluminium is melted.

In some of the German collieries it has been the practice to sprinkle water in the dusty parts of the mines with a view to preventing coal-dust explosions. The following modification of this process has recently come into use at some of the collieries, and is giving satisfactory results. Holes 1 metre deep are drilled at a distance from each other of about 3 metres, and in them wooden plugs are tightly inserted. Passing through the plugs are iron pipes from ⅔ to 1 metre long, with openings between 2½ and 3 millimetres wide. These apertures are connected with a pump, and water is forced in under pressure. At the Camphausen colliery, with a pressure of 8 to 10 atmospheres, an injection through two tubes during 8 hours proved sufficient to impregnate 6 by 1 by 1½ metres. At the Kreutzgraben colliery water forced in under pressure of 20 atmospheres during 16 hours moistened the coal 4 metres above the highest hole. In using this method a great deal depends upon the firmness of the coal seam.

During the year 1891, 48 miles of new telegraph lines, representing 71 miles of wire, were constructed in Switzerland.

The Japanese Government contemplate the construction of six lines of railway, aggregating 800 miles in length. The purchase of the private railways by the State is also projected.

Four or five miles from Hemsworth, on the estates of Lord Halifax and Mr. J. E Taylor, a great mining enterprise is being begun. An area of 2000 acres of coal, lying at a depth of 600ft., has been acquired, and the sinking of the shaft and all the other necessary works preparatory to starting what will be known as the Hickleton Main Colliery, are about to be carried out. It is expected that two years will elapse ere the first corve can be drawn.

Queries.

☞ Readers are invited to avail themselves of this section for practical information on questions relating to Mechanical Engineering and the Scientific Industries.

☞ Queries and Replies should arrive at the Manchester Office not later than by the first post on the Tuesday preceding the date of publication.

PLUMBERS' UNION.—Required the address of the secretary of the Operative Plumbers Union.—PLUMBER.

JAMES' PATENT SOUNDING MACHINE OR SUBMARINE SENTRY.—Can any reader oblige with particulars of this apparatus, or name of makers?—J. P.

MOULDING SAND.—Will any reader inform me where the fine moulding sand is obtained, the same as used for making small malleable iron castings in?—WALSALL IRON FOUNDER.

SPEED OF LOCOMOTIVES.—Provided a railway line is laid as perfect as possible, can any engine attain such a velocity as to cause it to leave the rails owing to excessive speed only?—P. T. G.

ROLLING CONTACT.—Can any reader kindly inform me if there are any machines in use for any purpose which have two rollers, cylinders, or the like, revolving in opposite directions at the *point of contact*?—W.

HOT-AIR ENGINE.—Will some reader of THE MECHANICAL WORLD kindly oblige me with a section and principal dimensions of a ½H.P. single-acting hot-air engine of the Stirling cycle?—GEO. H. PERKINS, North Queensland.

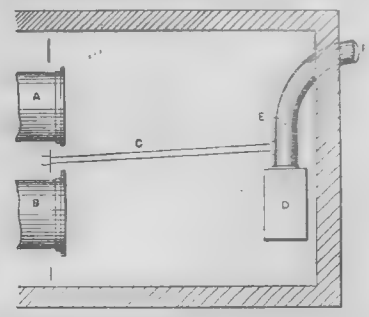
BOARD OF TRADE SURVEYORS. — Can any reader of THE MECHANICAL WORLD give me any information respecting Board of Trade surveyors? How are the situations obtained, particulars of examinations, etc.?—BOILER MAKER.

PEAT COAL.—I shall be very pleased if any reader of your valuable paper can give me some information on the above subject. I am desirous of knowing what firms manufacture it; its properties as a heating agent; what is its heating power in comparison with ordinary good coal; would it be a cheap fuel for firing boilers?—J. W. GEMMEL.

BOAT PROPULSION.—If a boat floats down a river, will it be carried forward at the same speed as the stream is flowing? Or can it be proved that it will go slower than the stream? How much force in lb. will be required to propel a boat of a given weight against a stream or up a river flowing with a certain velocity, so that the boat shall move up the river with the same speed that the stream is flowing down?—HYDRA.

CAMS AND BOWLS.—(1.) When subject to little pressure, studs work in the cam race without any roller or bowl on them. At what amount of pressure ought a roller to be used on the stud to work in the race? and how is the pressure on the stud to be calculated for a cam to turn rotary motion into to-and-fro straight motion if the groove or race is 12in. diameter and moves a bar 4½in. in each direction? (2.) What is the pressure on a wiper cam to lift 2cwt. at 1¾in. from shaft? and also, what is the strain on the cam shaft, and how can I find it for other wipers? (3.) What is the pressure on the ball bearing in a ball mill, and how is it found? The mill is to grind 75lb. at a time, and the ball works in a hemispherical footstep bearing and at end of inclined spindle, the top end of which makes a circle of 1ft. diameter in turning. Weight on spindle about 1 ton.—OATS.

STEAM JET.—Will any reader kindly enlighten me as to some plan for discharging ashes from the stoke-hole of a boiler house by means of a steam jet? My idea of such an arrangement will be best shown by the accompanying sketch, which is a plan of the front end of the boiler house. A and B are two Lancashire boilers, each about 28ft. × 7ft. diameter, and working at a pressure of 60lb. C, steam pipes from boilers ending in a nozzle E, which is inside the discharge pipes F. D is an iron box with a suitable air-tight lid. The ashes to be



discharged are emptied into the box D and the lid closed. Steam is then allowed to blow through the nozzle E. The suction thus caused is supposed to draw the ashes from D, which are then blown out through the discharge pipes F by the steam jet at E. In my case the vertical height from D to the point where the ashes would be discharged outside the boiler house would be about 13ft. A sketch with sizes of steam pipes, ashbox, and discharge pipes would greatly oblige.—G.A.B.M.

LOSSES IN STEEL FURNACES.—Could any reader kindly inform me the average per cent. of actual loss, and the average per cent. of skull, in the charge of a Siemens open-hearth steel furnace working charges of from 30 to 40 tons? And also the percentage of loss in heating slabs and ingots in the Siemens regenerative gas furnace?—J. R. R.

LOCOMOTIVE CONSTRUCTION.—Will any correspondent enlighten me as to the mode adopted in locomotive work in order to fix the position of the axles (horizontally) so that each axle may have a predetermined portion of the total weight resting upon it? Say:—

Load on leading axle	.....	0·32
,, driving ,,	.....	0·48
,, trailing ,,	.....	0·20
		1·00

Of course, I am aware there are certain circumstances—such as length of barrel, position of firebox, etc.—which in practice to a great extent influence this; but the point I wish clearing up is: Given the total weight, how are the positions of axles determined so that the prearranged weights rest on them? An answer would be of service to others as well as to—HILLSLAND.

Replies.

☞ Owing to the constant increase in our correspondence, we regret that we have no alternative but to announce that we cannot reply by post to Queries even when stamped envelopes are sent.

☞ Queries and Replies must in all cases be accompanied by the names and addresses of the writers, as no notice will be taken of anonymous communications.

VACUUM BRAKE.—Reynolds' "Continuous Railway Brakes" (9s.) will suit you.

A. TANNER.—Your best plan will be to apply to Mr. Albert Myers, 3, South-square, Gray's Inn, London.

J. GREENWOOD.—Messrs. Thomas Robinson and Sons, Rochdale, are makers of dovetailing machines.

CONDENSER.—The arrangement you suggest is not a good one. Why not allow the exhaust to discharge directly into the air, and muffle the outlet?

DERBY.—Phosphor tin is usually supplied for the purpose. The Phosphor Bronze Company Limited, 87, Sumner-street, Southwark, will supply you.

M. PATTERSON.—By the aid of a small triangular file and a little patience, you should experience no difficulty. Nick the glass completely round, and it will break clean.

AMATEUR.—Such particulars as you ask for would occupy too much of our space. Procure a copy of Croft's "How to Make a Dynamo," 2s., which contains full directions, and may be had from our office.

SPARK.—Oxygen is necessary for ordinary combustion, but an incandescent-electric lamp filament becomes heated owing to the resistance it offers to the passage of the current. There is practically no consumption of the material in the latter case.

CHRISTMAN.—(1.) Yes, we believe several engines have been so constructed, but (2) there is a difficulty with the gland packings. This, however, might now be overcome by using some good form of metallic packing. (3.) Engines so constructed would be more complicated, and the increased heating of the cylinder might also prove a serious objection.

A. M.—To put the matter as plainly as possible: Multiply the diameter of the cylinder in inches by itself, and the product by 0·7854. Thus, for a 10in. cylinder, 10 × 10 × 0·7854 = 78·54. Multiply this by the mean effective pressure per square inch, and the resulting product by the piston speed in feet per minute. Then divide this result by 33,000, and the quotient will be the indicated horse-power.

QUESTION.—No; a partner in an English patent cannot obtain an American patent for himself, unless he is the sole inventor and the others have merely a monetary interest in the invention. If he is actually a joint inventor he cannot, without the consent of the other partner. The manager of our patents department will be pleased to transact any patent business for you on your writing him.

MAKERS OF SMALL CASTINGS.—Required the names and addresses of makers of light pattern worm wheels and small furnishing wheels.—H. M.——*A.*—In reply to "H. M." Messrs. H. Wallwork and Co., Manchester, make all kinds of light castings such as he requires.—FOREMAN PATTERN MAKER.——*A.*—Apply to Messrs. Senior and Co., Otley.

WOVEN BELTING.—Can anyone give me the recipe for or supply me with the proper paint for cotton belting? I can weave it right enough, but cannot get a satisfactory paint.—BARCELONA.——*A.*—I believe cotton belting after being woven is treated with boiled linseed oil and dried, afterwards painted with ordinary red lead or iron oxide paint.—J. R. T.

MAKERS OF COMPRESSED PAPER.—Will any reader inform me of the address of a maker of compressed paper, such as is used for carriage wheels and the like?—T. D.——*A.*—You will get all information from W. S. Dougall, engineer, Radcliff-on-Trent, Notts.—T. H.——*A.*—The Universal Barrel Company Ltd., Two Waters Mill, Boxmoor, Herts, are makers of compressed pulp and pulp goods.—J. R. T.

MAKERS OF STAMPED FORGINGS.—Required the names and addresses of firms making drop stamped joints and pins in small quantities.—J. T.——*A.*—If "J. T." will send us drawings or samples of the stampings he requires, we will supply his wants. Messrs. Thomas Hill and Co., 40, St. Enoch-square, Glasgow.——*A.*—Messrs. Hodder and Bullock, Broughton Bridge Ironworks, Manchester, or their agent, Mr. A. L. Underwood, of 60, Queen Victoria-street, London, supply all kinds of drop stampings.—J. R. T.

VOSPER'S ENGINE.—I have a Vosper's patent high-speed four-cylinder engine, and should be glad to know what the cut-off in each cylinder should be; also the position of eccentric sheave at any given point? I believe the eccentric sheave has been altered before the engine came into my hands. A sketch would oblige.—R. F.——*A.*—"R. F." asks for a sketch, but if he would send a sketch of his engine, showing position of eccentric, he would have a better chance of getting assistance. Everyone does not know what a Vosper engine is like.—H. P.

HEATING RIVETS.—I should be glad to learn who was the patentee of the oil system for heating rivets on the Forth Bridge, and if it was successful in practice.—H. A.——*A.*—If "H.A." will communicate with me, I will give him full particulars as to the invention of the oil system for heating rivets at the Forth Bridge, which I may here inform him was a very great success. Thos. Hill, 40, St. Enoch-square, Glasgow, manager of the hydraulic and machinery department at the Forth Bridge during construction.

BOILER INSPECTORS.—Will any reader inform me as to the nature of examinations held for boiler inspectors, and if there are any books treating on same?—BOILER MAKER.——*A.*—The qualification for a boiler inspector is a thorough knowledge of his trade as a practical boiler maker, and with the necessary education pertaining to the working, calculating, setting, repairing, testing, and making of same; making drawings for any kind of boiler, and foundation drawings for repairs; reporting on defects, etc., etc. This can only be got by experience in the workshop and a thorough working up of the education connected with the profession, and the editor, no doubt, can give you the names of many manuals on boiler making that will assist you; but you must be a boiler maker.—FLUE.

HARDENING CIRCULAR SAWS.—Can anyone tell me how to harden a circular saw 20in. diameter and ⅛in. thick, to saw cast iron? I want to harden the cutting part only, and not the body of the saw.—J. WILSON.——*A.*—This is a process or a trade by itself, and the necessary tools and appliances you require would cost more than twenty new saws similar to the one you wish to harden. You will find it much better to send it to a saw maker, unless you want to learn the trade.—"DRUNK SAW."——*A.*—Heat the saw to a cherry red, and quench in oil. When cold, brighten one side of it; then get a cast-iron heater 4in. smaller than the saw and ⅛in. thick, and heat it to a bright red. Place it on the middle of saw, and let it remain there until the teeth show a pale straw colour; then cool in oil. If the saw buckles it must be hammered true with a cross-payne hammer.—T. MANWARING.

STEEL CASTINGS.—Will any correspondent enlighten me as to the method of casting buffer boxes for railway vehicles in steel? What would be the best kind of pattern to use—wood or cast iron,—and would it require to be in two halves with core box? I should like the address of a firm that would undertake the making of such. Can they be cast in the open sand?—ENGINEER.——*A.*—Either a wooden or cast-iron pattern could be used, not necessarily in halves, but better so, especially if a number are wanted; a half-core box will suffice. They *cannot* be cast in open sand. Messrs. P. R. Jackson and Co., of Manchester, or Messrs. Jessop, of Sheffield, are likely firms.—FOREMAN PATTERN MAKER.——*A.*—Send your questions to the Bowling Iron Company Limited, Bradford, and they will give you every assistance, it being a speciality of theirs.—THOS. HILL.——*A.*—Messrs. H. Senior and Co., Otley, will supply you.

WHEEL MOULDING MACHINE.—Required the makers of a good wheel moulding machine for toothed wheels up to 6ft. diameter.—SMALL FOUNDER.——*A.*—Messrs. Whittaker, of Oldham, or Messrs. Buckley and Taylor, of the same town, are makers of machines up to any size of wheel.—FOREMAN PATTERN MAKER.——*A.*—If "Small Founder" will send his name and address and full particulars of his wants to Messrs. Thomas Hill and Co., 40, St. Enoch-square, Glasgow, we will supply him with a wheel moulding machine of newest design.——*A.*—A neat and simple but effective machine is sold by Messrs. Doddrell Brothers, 11, Bothwell-street, Glasgow. I saw one at work, and was struck with its simplicity. Instead of the usual gears a large division drum and stop-peg are used, by which any number of teeth can be accurately moulded. The machine would mould wheels up to 15ft. in diameter. Smaller sizes are also made, which would no doubt suit the requirements of "Small Founder."—W. T. S.

Latest Inventions.

APPLICATIONS FOR LETTERS PATENT.

When Patents have been "communicated," the name of the communicating party is printed in italics.

Where complete specification accompanies application, an asterisk is suffixed.

5th September, 1892.

15,874 APPARATUS for HEATING STEAM BOILERS. R John.
15,876 TELEPHONIC INSTRUMENTS. J Muirhead.
15,880 CALCINING FURNACES. A Dauber.
15,881 VICES.* F C Brebeck and J Kempnich.
15,883 SPRING APPARATUS for USE with WHEELS. I M Bourke.
15,887 APPARATUS for OBTAINING METALS by ELECTROLYSIS. H H Frei.
15,889 VALVES for the CUT-OFF GEAR of STEAM ENGINES. E Wigzell.
15,900 WATER GAUGES for STEAM BOILERS. R W Barker. (*F H Hausman*, United Sates.)
15,902 STEAM BOILERS.* H F Cook and others.
15,908 MEANS for PROPELLING VESSELS. C K Mills. (*C S Merritt and others*, France.)
15,913 SHIELDS of AXLE BOXES. W Hutton. (*M Brown*, South Africa.)
15,922 SHIPS' WINDLASSES. F U and A W Baxter.
15,924 APPARATUS for GRINDING or REDUCING PHOSPHATES, BONES, ETC. J U Askham.
15,925 PURIFICATION of COAL GAS. J J Hood and A G Salamon.

6th September, 1892.

15,930 CARPENTER'S BRACE and RATCHET COMBINED. A C Fisher.
15,935 STEAM TRAPS. J Wild.
15,938 LOCOMOTIVE STEAM ENGINES. C V Wellwood.
15,948 ARRANGEMENT and CONSTRUCTION of LUBRICATORS. W H and R Thompson.
15,952 ROLLS for SHAPING CONNECTING PLATES for the JOINTS of RAILWAY RAILS.* H D Fitzpatrick. (*The Continuous Rail Joint Company*, United States.)
15,959 PNEUMO-DYNAMO METERS. E and E Savary d'Odiardi.
15,964 MORTISING MACHINES.* J T Knowles. (*L A Belmont* and *A C Cload*, United States.)
15,970 APPARATUS for BENDING and SHAPING METAL PLATES. E Redman and others.
15,972 PULLEYS and BANDS for DRIVING MACHINES from ELECTROMOTORS. Siemens Brothers and Co. Limited. (*Messrs. Siemens* and *Halske*, Germany.)
15,973 STEAM BOILERS. C B Burdon.
15,975 CRUSHING and PULVERISING CYLINDERS. J R Alsing.
15,976 PULVERISING and MIXING CYLINDERS. J R Alsing.
15,977 AERIAL MACHINES.* S B Battey.
15,983 DETECTOR BARS for RAILWAY POINTS and SIGNALS. L B Stevens.
15,988 ROLLERS of PORCELAIN, WOOD PULP, PAPIER-MACHÉ, ETC., for CRUSHING or GRINDING PURPOSES.* A C Anger.
15,991 COMPOSITIONS of MATTER SUITABLE for USE for BEARINGS, PACKINGS, PROJECTILE GUIDES or RINGS, and ELECTRICAL CONDUCTORS.* P H Holmes.
15,992 COMPOSITION BEARINGS, PACKINGS, and PROJECTILE GUIDES or RINGS.* P H Holmes.
15,993 COMPOSITION BEARINGS.* P H Holmes.
15,994 ELECTRICAL CONDUCTORS.* P H Holmes.
15,996 PORTABLE POWER TRANSMITTING DEVICES. E D Weyburn.
15,997 WORKMEN'S TIME RECORDERS. W La Grande Bundy.
15,998 ELECTRIC CIRCUITS and CABLES.* A V Newton. (*J A Barrett*, United States.)
15,999 ELECTRICAL CIRCUITS and CABLES.* A V Newton. (*J A Barrett*, United States.)
16,001 RAILWAY CAR JOURNAL BOXES.* C T Schoen.
16,002 GAS-FIRED FURNACES for HEATING, RE-HEATING, and ANNEALING PURPOSES. H F Taylor.
16,004 LIGHTING APPLIANCES. B Willcox. (*C Deselle*, France.)

7th September, 1892.

16,033 MEASURING INSTRUMENTS for RAILWAY USE. W P Thompson. (*C Wolff and Co.*, Germany.)
16,037 SIGNALLING and INDICATING APPARATUS for USE on RAILWAY TRAINS, STEAMERS, and TRAMCARS. C A Devenish.
16,039 DECKLE STRAPS for PAPER-MAKING MACHINES.* J Cockburn.
16,041 SWITCH LEVER MECHANISM for RAILWAYS. J Sheldon.
16,042 MECHANISM for TRANSMITTING MOTION FROM, and for LOCKING and INTERLOCKING the LEVERS of RAILWAY SIGNALS and SWITCHES. J Sheldon.
16,054 APPARATUS for MANUFACTURING RECTANGULAR-MESHED WIRE NETTING.* A N Pearson and R Penn.
16,055 DYNAMO-ELECTRIC MACHINERY. T R Freeman and W W Pope.
16,063 RAILWAY SIGNALLING APPARATUS. L B Stevens. (*A H Johnson*, United States.)
16,066 APPARATUS for PROPELLING SHIPS. H H Leigh. (*G Storz*, Germany.)
16,067 CAISSONS. J F O'Rourke.

8th September, 1892.

16,076 WIND MOTORS. C G Saunders.
16,078 HIGH-SPEED ENGINES. F Rollason.
16,085 AXLE BOXES for RAILWAY VEHICLES. P Le Doyen.
16,089 MARINE ENGINE GOVERNORS. R B Kinniburg.
16,096 TOOL STEEL BARS. W F Beardshaw.
16,099 ACTUATING the BRAKES of RAILWAY WAGONS. J E Clough.
16,100 SIGNALLING at SEA. W Robson.
16,105 TRUNKS or PIPES for the CONVEYANCE of WASTE PRODUCTS of COMBUSTION and STEAM from the LOCOMOTIVES of UNDERGROUND RAILWAYS.* G Dalton and G Bray.
16,106 TEMPERATURE INDICATOR, APPLICABLE to OVENS, BOILERS, ETC. C Heirons.
16,108 HYDRAULIC ACCUMULATORS. R Haddan. (*E and Ch Bouhey Fils*, France.)
16,110 AUTOMATIC APPARATUS for INDICATING in a RAILWAY TRAIN the SUCCESSIVE STATIONS. F V Russell.
16,114 SIGNALLING, ANNOUNCING, and ADVERTISING by ELECTRIC LIGHT on the CLOUDS. E Curtice.
16,118 SUGAR CANE CRUSHING MILLS. G Fletcher.
16,123 STEAM and OTHER FLUID ENGINES. T H Williams.
16,124 TELEPHONIC SWITCHING APPARATUS. A R Bennett.
16,126 SOLDERING JOINTS of ELECTRIC WIRES. W Moseley.

9th September, 1892.

16,129 BRAKE BLOCKS for RAILWAYS, ETC. P Griffiths and A Poole.
16,132 SLUICE VALVES. G Watson.
16,134 GAS FURNACES. F J Clinch-Jones.
16,138 TRANSMITTING TELEGRAPHIC SIGNALS THROUGH SUBMARINE CABLES. H A C Saunders.
16,142 TELEGRAPHIC RECEIVING INSTRUMENTS. J F Hoffgaard. (*H P Fryd*, Denmark.)
16,145 WATER GAUGES for BOILERS. A Shiels.
16,150 PERFORATING MACHINES. A Partridge.
16,157 RATCHET SPANNER. W Miles and A W Arthurton.
16,158 SIGNAL LIGHTS and ROCKETS for MARINE PURPOSES. J Pain.
16,161 DUST-PROOF BEARINGS and CONES for HUBS or WHEEL SPINDLES. W Clews.
16,163 FISH-JOINT for RAILWAYS.* W Sandford and others.
16,164 APPARATUS for PRESERVING the TAIL SHAFTS of STEAMERS from CORROSION. T Mudd.
16,168 PROCESS for MANUFACTURING THIN STEEL or IRON SHEETS DIRECT from INGOTS or BLOOMS.* K Wittgenstein.
16,170 SCREW NUT for SCREW BOLTS. W F D V Ollefen.
16,173 PROCESS of REDUCING UNSMELTED ORE.* J T Wainwright.
16,176 APPARATUS for MEASURING ELECTRICITY. E H P Humphreys and W Friese-Greene.
16,184 MANUFACTURE of OXIDE of LEAD and of WHITE LEAD from CRUDE SULPHATE of LEAD. P Bronner.
16,188 THREAD CUTTERS. F J Höhs.
16,193 HYDRAULIC MACHINERY. G Mitchell.

10th September, 1892.

16,194 CRAVEN'S DOUBLE-PURCHASE AUTOMATIC BACK GEAR. J Craven.
16,195 CENTRIFUGAL MULTIPLYING SPEED GEAR. E J Nugent.
16,198 VALVES. W W Horn. (*A T Miller*, United States.)
16,201 GALVANIC BATTERIES. J B Fachris.
16,217 LEVER FOG SIGNAL SELF-ACTING APPARATUS. C J Johnson.
16,234 COATING or PLATING ALUMINIUM with OTHER METALS. G Selve.
16,243 TURNING, PLANING, and BORING TOOLS HAVING a DISC-SHAPED CUTTING TOOTH.* N Browne. (*B Fischer* and *G Winsch*, Germany.)
16,245 HOT-AIR MOTOR. O Spaethe.
16,246 PROCESS for OBTAINING ALUMINIUM. B Dukes. (*J Rose*, Germany.)
16,251 STEAM GENERATOR. J Hawley.
16,254 ELECTRICAL SWITCHES, SOCKETS and CUT-OUTS. S T Wyand and L Schramm.
16,260 APPARATUS for REDUCING PRESSURE in PIPES. F W Cannon and J A Bauer.
16,263 APPARATUS for STOPPING and STARTING RAILWAY VEHICLES. R Schrodlein.

Manuscript Specifications of Patents can be examined at the Patent Office, London, after the Complete Specification has been accepted, on payment of 1s. The printed Specifications are usually published in about one month after acceptance of the Complete Specification, and any single copy may be obtained by remitting 8d. in stamps (or by special post cards sold at the Post Offices at 8d. each) to SIR H. READER LACK, *Comptroller General, Patent Office, 25, Southampton-Buildings, Chancery-lane, London. When a number of Specifications are required, remittances may be made by P.O.O.*

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FRIDAY, SEPTEMBER 30TH, 1892.

High-speed Spur Gearing.

ALTHOUGH convenience in distributing power, and reduced first cost, had much to do with the substitution of rope driving for spur-gearing, there were other subsidiary, but nevertheless important advantages which rope transmission offered over the older system of gearing, which have assisted to bring it into almost general use for cotton-mill driving. Not the least of these is the high speed at which, when ropes are used, it is possible to drive the second-motion shaft, while transmitting fairly large powers. There can be no question that well-made gearing, running at moderate speeds, is a much more efficient method of power transmission than any system of rope driving; and, conscious of this fact, some few engineers are endeavouring to meet the requirements of cotton-mill driving by furnishing machine-cut wheels and pinions for the purpose. Unless, however, very great care is exercised in the construction of the wheels, and substantial foundations are provided, high-speed spur gearing is not without its troubles. This is very clearly shown by the chief engineer's report to the Engine Boiler and Employers' Liability Insurance Company Limited for 1891, wherein we find attention directed to several breakdowns of spur wheels running under the conditions named above. In one case cited, a cast-iron spur fly-wheel of 120 teeth, and a cast-iron pinion of 42 teeth, 5⅛ pitch and 18in. broad, transmitted about 1100 H.P. at surface speed of 2242ft. per minute. In June, 1890, several of the teeth in the spur wheel were found to be cracked at the roots, and a new machine-moulded spur rim was fitted to the wheel, and the pinion teeth were chipped. The new rim only ran until January, 1891, when one of the segments was found to be broken completely across, and several teeth were cracked at the roots. The second case was a pair of engines transmitting 1200 I.H.P. After breaking down in 1888, a cast-iron wheel, with 170 teeth shrouded to the pitch line, and a steel pinion with 52 teeth, 4⅛in. pitch by 19in. broad, were put in. The mean pressure on the teeth was 16,430lb., and the pitch surface speed 2410ft. per minute. In March, 1889, the gearing again broke down. A new steel spur rim has now been fitted, the teeth on which are considerably shorter than usual, and the results have shown this departure to be a step in the right direction. Mr. Longridge has long advocated the use of shorter teeth than are at present generally adopted, and certainly he can adduce many facts in support of his contention. But it is difficult to persuade makers of spur wheels, especially those of the old school, that under such circumstances as those referred to, short teeth are in every way superior to the orthodox tooth of two-thirds to three-quarters the pitch in length. But they are cheaper in the first instance, and as this is a point of great moment nowadays, we may yet see some progress made in the direction indicated.

The German Railroad Union Awards.

IN 1890 the German Railroad Union offered several prizes, which have recently been awarded as follow:—A prize of 7500 marks to Mr. von Borries, of Hanover, for improvements in compound locomotives; a prize of 3000 marks to George Westinghouse, jun., for improvements in his atmospheric brake; a prize of 3000 marks to Paul Langbein, of Saronno, for an apparatus for transferring standard-gauge cars to narrow-gauge railroads; a prize of 1500 marks to Mr. Wedler, shop clerk in Magdeburg, for apparatus for protecting men working at lathes; a second of 1500 marks to Mr. Volkmar, of Strasburg, for improvements in movable axles; a third to G. Häutzel, mechanicel engineer in Strasburg, for a paper on the behaviour of track ballast in statical relations; a fourth to Professor Launhardt, of Hanover, for his treatise on "The Theory of Location"; a fifth to Railroad Inspector Kolle, of Berlin, for a work on apparatus for protecting switches and signals; a sixth to Ludwig Kohlfürst, of Kaplitz, Bohemia, for a work entitled "The Development of Electrical Railroad Appliances."

The Trolley System.

FOR some reason or other a section of the American daily papers, and particularly some in New York, have started a crusade against the proposed introduction in the latter city of the trolley system of electric traction. The opposition was commenced when the Union Railway Company projected the operation of a number of trolley lines in the northern suburbs of the city, beyond the Harlem. It was contended that the trolley was a death-dealing monster, and that many persons had met with fatal accidents owing to the use of that method of locomotion. A very searching investigation has, however, been made, and the mayors of the various cities where lines are in service up to as much as 48 miles in length report that the electric lines are highly popular, that they are as safe as can be, considering the speed of transit, and that few accidents occur, because the people soon become educated to the high speeds, and exercise due caution. It has, moreover, been shown that 98 per cent. of the accidents attributed to electricity were due to other causes—due to the same elements which prevail on the horse and cable lines It is, however, satisfactory to note that the aldermen have now granted, and the mayor has confirmed, an extensive concession to the above-mentioned company for the working of a number of lines in the northern suburbs of New York, where the trolley method is regarded as the best suited to local requirements.

Steam Engines in Electricity Works.

PARTICULARS have been published concerning the employment of steam engines in electricity works in Germany. At the beginning of 1891 the number in use in these establishments comprised 1·59 per cent. of the total in operation in that country, this being increased at the commencement of the present year to 1·94 per cent. In Berlin, which stands first in the application of electrical energy, an augmentation of 21·5 per cent. has taken place in the employment of steam engines, during the past two years, for the driving of dynamos. The district of Düsseldorf is said to occupy the second position, the percentage increase being slightly less than that in Berlin. These figures do not, however, carry much weight. It would have been preferable had the compiler given definite numbers.

Wire Rope Transport.

A WIRE ROPEWAY for conveying materials of construction to the site of the fort of Tournoux, near Condamine, in the department of Hautes-Alpes, is described in a foreign contemporary. The difference of level between the two stations is 1525ft., the horizontal distance 2307ft., and the length of the cables 2766ft. The load carried is 10cwt., and 10 journeys are made in the hour. The system employed is that of stretching two fixed cables to carry the loads, and to employ an endless cable to haul them. The carrying cables (which are in one span for the whole distance) are of a diameter of 1·2in., and the hauling cable of 0·56in.; they are made with a hemp centre of six strands, having six wires each. A steam engine of 15H.P. is used. The rope is kept in tension by passing round a sheave on a movable carriage at its upper end. The driving machinery is at the foot. The drum is 6ft. 7in. in diameter, and the rope has only one half turn on it. The cost of the whole installation was £1200, and the working expenses and maintenance £1 8s. 2d. per day, to which may be added £2 per day for the purpose of extinguishing the capital outlay. This gives the cost per ton at 1s 4½d. nearly, when 50 tons are carried per day, whereas by carts it would have cost over 6s. 8½d. per ton.

Electrical Transmission Plant.

AN electric power transmission installation is now in course of construction at Albino, near Bergamo (Lombardy), which, it is stated, will combine a degree of completeness with simplicity not yet equalled by other similar plants. The primary power will be furnished by the River Serio, across which a dam has been built for storage purposes. The water will be carried to a turbine station at Cene through a canal 800 metres (2624ft.) long, and a main 550 metres (1804ft.) long, and 1800mm. (6ft.) in diameter, the available head at the station being 15 metres (about 50ft.). There will be three turbines of 325H.P. each, which will drive the generator armatures directly, without the intervention of belting or gearing. The current will be carried through a line supported on wooden poles for a distance of 3000 metres (nearly 2 miles), to supply the spinning and weaving mills of Messrs. Honegger, Spoerry and Co., at Albino. The motors in the mills will drive a number of line shafts by rope transmission. The commercial efficiency of the whole system is placed at 80 per cent.

Axle and Tyre Failures.

DURING the quarter ending March 31, there were 153 failures of tyres in Great Britain and Ireland. Five were engine tyres, 3 were van tyres, and 145 were wagon tyres. Of the wagons, 115 belonged to owners other than the railway companies; 127 tyres were made of iron, and 26 of steel. One of the tyres was fastened to the wheel by Mansell's patent method, one by Gibson's patent method, 100 by bolts or rivets, 12 by other methods, and 39 by methods which were not stated. Sixteen tyres broke at the rivet holes, 21 in the solid, and 116 split longitudinally or bulged. Of the 71 axles which failed, 44 were engine axles—viz, 35 crank or driving, and 9 leading or trailing; 6 were tender axles, 1 was a carriage axle, and 20 were wagon axles. Eight wagons belonged to owners other than the railway companies. Of the 35 crank or driving axles, 5 were made of iron and 30 of steel. The average mileage of 5 crank or driving axles made of iron was 280,641 miles, and of 30 crank or driving axles made of steel 227,936 miles.

The Under-type Stationary Engine.—XIX.

WE shall show a wrought-iron raised manhole, in section, on one of the locomotive boilers to be illustrated, as referred to in our last article. The mudholes are of oval shape, generally 3½in. by 2½in., punched out by hydraulic or power pressure; they are fitted with cast-iron lids and wrought-iron crossbars. In large boilers, when the firebox front and saddle plates are flanged to a large radius, the mudholes are cut in the corners, this being the most convenient place for raking out the mud. When the firebox front and back plates are flanged to a small radius, the mudholes are placed as near to the corners as possible. Taper-screwed plugs of brass are sometimes used, but the thread in the boiler plate is liable to be damaged by the repeated raking process, which causes the plug to leak. We have seen wrought-iron mudholes with external threads, similar to Fig. 32, riveted to the plates, making a good job; no amount of raking can therefore do any damage. Four mudholes are mostly arranged near the bottom of the firebox, and one is placed at the bottom of the smokebox tube-plate. Frequently a mudhole is placed above the firehole ring, and another below.

Large locomotive boilers, when placed alongside the engine, are often specified to have steam domes. Figs. 29 and 30 show an end elevation and plan of an approved type of dome or steam drum. It will be seen that it consists of a barrel with two flanged end plates, one flange turned inwards and the other outwards, so that all the riveting may be done by hydraulic pressure; the blocks, like Fig. 27, on the end of the drum and on the top, are intended for the stop valve and the safety valve; these two fixings and the neck must be riveted to the dome before the end (having the flange outwards) is inserted. The drum is mounted upon the boiler barrel by means of two strong wrought-iron necks, one riveted to the dome and the other to the boiler, with a strengthening ring inside the boiler. The two necks are provided with a flange, so that they can be bolted together, this being a very convenient plan in many ways. For export, for instance, it is often necessary to send the dome loose, for the purpose of reducing the shipping dimensions.

When the drum is of great length it is attached to the barrel of the boiler by means of two necks. In some instances a pair of boilers are worked together, and the drum is mounted over them crosswise, and serves as a steam reservoir common to both boilers, by means of a neck on each boiler barrel. The vertical dome is occasionally used, the barrel of which is welded and flanged round the bottom and secured to the boiler by a double row of rivets; a good strengthening plate must be riveted round the hole. An angle-iron ring is sometimes riveted inside at the top, and a steel dished cover bolted to the angle iron, which is faced. A neat charcoal iron casing then covers the dome, in locomotive fashion. There are other methods of forming domes, but we prefer the one illustrated by Figs. 29 and 30.

It is customary with some makers to provide a mud collector underneath the barrel of the boiler near the firebox tube plate. This often consists of a [illegible] Fig. 31, having an oval hand hole [illegible]

cast-iron cover and a wrought-iron crossbar. Sometimes an outside cover is used, secured by bolts. In other cases a cock is bolted to the fixing in lieu of the hand hole. For very large boilers two mud collectors should be specified, one at the smokebox end, near the water inlet, and another near the firebox tubeplate. It is very important that all locomotive boilers of large size should have four or six wash-out or hand holes on the firebox casing, level with the firebox top. By means of these holes the scale can be scraped off the top of the firebox. If roofing

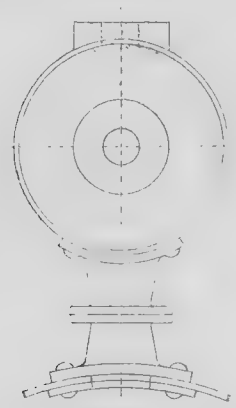


FIG. 29.

bars are used, the wash-out fixings must be arranged so that a rake can be inserted beneath the bars. These wash-out holes are occasionally made and equipped like the mudholes, but we show at Fig. 32 a good type. It will be seen that a brass flange with nipple and outside thread is bolted to a wrought-iron block; a brass lid screws on to the flange, and a steam-tight joint is made, the top of the nipple and the inside of the cap being both faced to secure this result.

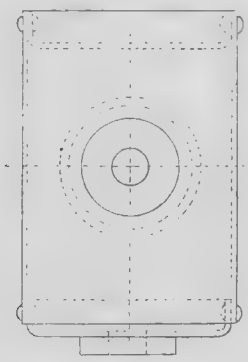


FIG. 30.

We will now give a list of the mountings or seating blocks required for the fittings on large locomotive boilers.

Nine seatings will be required, like Fig. 27, of suitable size, for the stop valve, double spring safety valve, check valve, and six wash-out plugs; one manhole, of the raised type; two mud collectors like Fig. 31—these may be of cast steel if preferred, with cast-iron lid and wrought-iron crossbar.

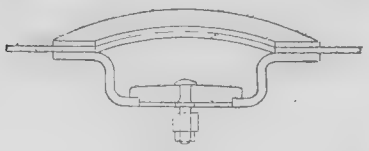


FIG. 31.

In addition to the above seating blocks, the boiler will require a firehole door and hinge; a wrought-iron ashpan with suitable bearer bars for the firebars. In some cases a firebrick arch is adopted in large boilers with beneficial results. Two wrought-iron strips will be required on the sides of the firebox for supporting the arch; a wrought or cast-iron chimney base; smokebox door of the dished type, and central handle; two strong lifting rings. The wrought-iron ashpan is usually made

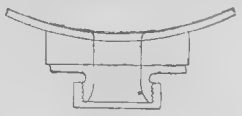


FIG. 32.

to serve for the underneath engine or for the separate boiler; for the latter, however, a support will be needed at the smokebox end.

In a future article we shall illustrate the fittings required, and there are some internal constructive details that we must refer to when the sectional views of the boilers appear.

(*To be continued.*)

Machine Construction.

THE CONSTRUCTION OF MACHINE ELEMENTS.

(*Continued from page* 121.)

§ 136.

AXLES WITH THREE OR MORE BEARINGS.

THE number of bearings for an axle is often as great as four. In such a case the forces and moments may be found as follow:—

Starting at a, Fig. 409, with the given forces 1 to 5, we form the force polygon a_5 O, and according to § 40, the link polygon $a\ b\ c\ d\ e\ f\ g$, and join the closing line $g\ a$, parallel to O 6, in the force polygon; giving 5 . 6 = the force P_3 at G, 6 . a = the force P_1 at A. From P_1 and P_3 the journals d_1 and d_2 may be determined, and the ordinates of the cord polygon give the means of obtaining the axle diameter as before.

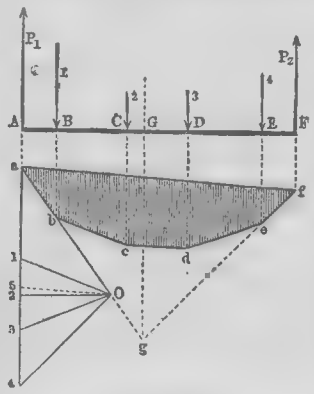


FIG. 409.

The intersection g, of $a\ b$ and $f\ e$, prolonged, is a point of the line of direction G g, of the resultant of the forces 1 to 4. If it is desired to find the successive resultants of the various forces as they are combined (see § 40), it will be found convenient to choose O, so that $a\ f$ will be parallel to A F. The inclined link polygon may also be transferred to a closing line parallel to A F.

If the shanks of the axle overhang the journals, as Fig. 410, the procedure is similar to the preceding.

Beginning at the point a, the force polygon a 5 O is constructed, and the first side of the cord polygon $b\ a$ drawn to the line of the first force, the second to the line C c of the second force, and so on to the closing line $e\ b$. The first and n^{th} line of the cord polygon intersect as before on the line H h of the resultant. Variations on these examples may occur, as when the loads act in inclined directions, or opposed to each other, the methods being similar in all cases.

§ 137.

AXLES WITH INCLINED LOADS.

The analytical investigation of axles becomes more difficult when, as in Fig. 411, the loads act in different planes, but the graphical method is readily applied. The force polygons A O_1 1, and D O_2 2, are constructed for the forces Q_1 and Q_2, respectively, Fig. 412, the polar distances G O_1 and H O_2 being made equal to each other, so that the closing lines of the two cord polygons A b' D, and A c'' D, coincide in A D. Then construct the second cord polygon with the inclined ordinates B B'' = B b'', C C'' = C c'', etc., making the angle u with the force plane of the ordinates of the first polygon, and inclined backwards as drawn. Then make B b = B'' b', C c = C'' c', E e = E'' e', etc., and draw the cord polygon A $b\ e\ f\ c$ D, from which can be obtained (according to § 44) the bending moments for the axle. The line $b\ e\ f\ c$ is a curve (hyperbola), A b and c D are straight lines. Draw O_1 O_1' parallel to A 1, O_2 O_2' parallel to D 2, and drop the perpendiculars O_1' I and O_2' K, and A I will be the force on the journal P_1, and D K that at P_2, measured on the scale of the force polygon. Their directions are determined by combining A G with H 2, and D H with G 1 at the angle u.

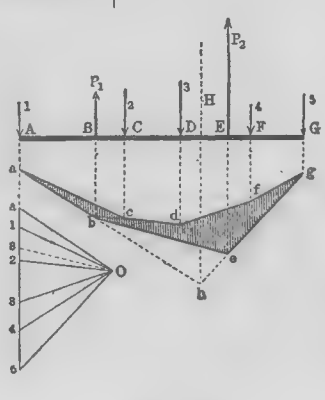


FIG. 410.

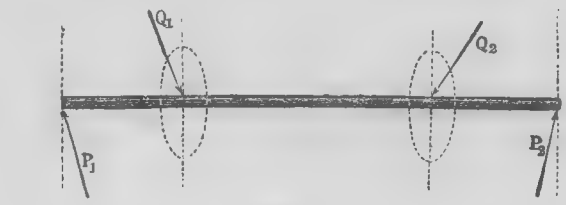


FIG. 411.

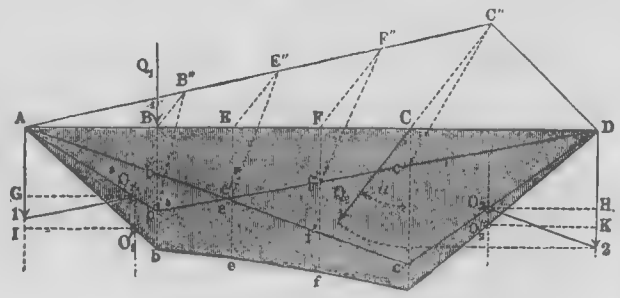


FIG. 412.

$\frac{b}{h}$	VALUES OF $\frac{h}{y}$ WHEN $\frac{k}{h}$												
	0·80	0·75	0·70	0·65	0·60	0·55	0·50	0·45	0·40	0·35	0·30	0·25	0·20
0·05	1·30	1·40	1·50	1·61	1·72	1·84	1·94	2·04	2·15	2·18	2·22	2·23	2·27
0·06	1·30	1·39	1·48	1·58	1·63	1·79	1·87	1·95	2·02	2·07	2·11	2·13	2 11
0 07	1·29	1·38	1 46	1·56	1·65	1·74	1·82	1·89	1·94	1·93	2·00	2·02	2·02
0·08	1·28	1·36	1·45	1·53	1·62	1·70	1·76	1·83	1·87	1·91	1·93	1·93	1 93
0·09	1·27	1·35	1·43	1·51	1·59	1·66	1·72	1·77	1·81	1·84	1·86	1·87	1·87
0·10	1·27	1·34	1·42	1·49	1·56	1·63	1·68	1·72	1·75	1·78	1·80	1·80	1·81
0·11	1·26	1·33	1·40	1·47	1·54	1·60	1·64	1·68	1·71	1·73	1·74	1 75	1·75
0·12	1·25	1·32	1·39	1·45	1·51	1·57	1·61	1·64	1·67	1·68	1·69	1·70	1 70
0·13	1·25	1·31	1·38	1·43	1·49	1·54	1·58	1·61	1·63	1·64	1·65	1·65	1·65
0·14	1·24	1·30	1·36	1·42	1·47	1·51	1·55	1·57	1·59	1·60	1·61	1·61	1·61
0·15	1·23	1·29	1·35	1·40	1·45	1·48	1·52	1·54	1·56	1·57	1·58	1·58	1·58
0·16	1·23	1·28	1·34	1·38	1·43	1·46	1·49	1·52	1·53	1·54	1 55	1·55	1·55
0·17	1·22	1·27	1·33	1·37	1·41	1·45	1·47	1·49	1·50	1·51	1·52	1·52	1·52

B. AXLES WITH COMBINED SECTION.

§ 138.

ANNULAR SECTION.

If it is desired to make an axle with annular section, or, in other words, a tubular axle, the journals should first be calculated, according to the method given in § 90 for tubular journals, and then, iron the cruciform section, with circular centre and four ribs, is sometimes used. The shanks are then usually made of the ordinary conoidal form (Fig. 413), and in some cases the ribs gradually swell into a junction at the ends with the central core (Fig. 414).

In designing such an axle, first proceed as if drawing a solid circular section as shown by the dotted lines, of the diameter corresponding to the portion K when the ribs join the head. Then for any point (x) of the shaft:—

y = the diameter of the assumed round axle, or equivalent conoid;

h = height of ribs;
b = thickness of ribs;
k = diameter of core;

and the proportions are obtained from the following formula:—

$$\frac{y}{h} = \sqrt{\left(\frac{k}{h}\right)^4 + \frac{16}{3\pi}\left\{\left(\frac{b}{h}\right)^3\left(1-\frac{k}{h}\right) + \frac{b}{h}\left(1-\frac{k}{h}\right)^3\right\}} \quad ..(127)$$

This formula serves for the pure cruciform section, without core, by making $k = b$.

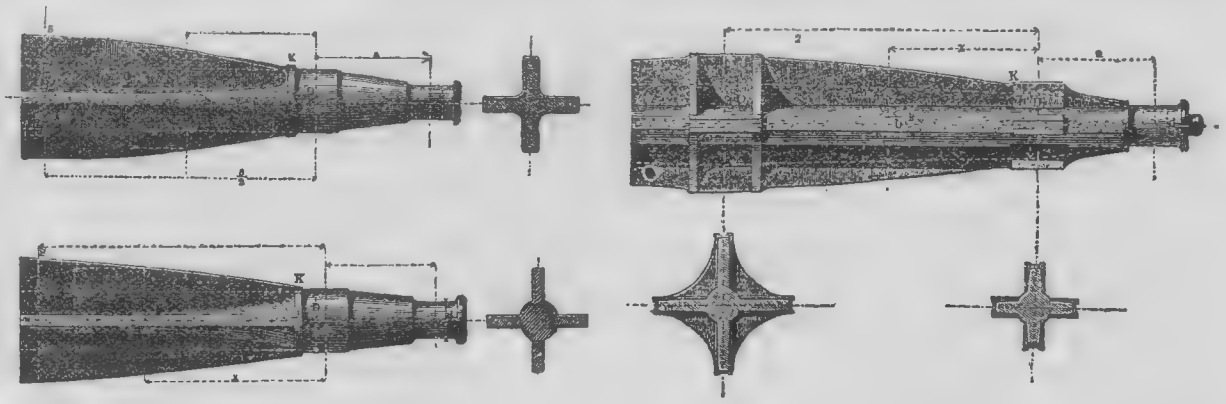
The results vary so slightly when $k = 0{\cdot}2\ h$, that the following table may be used for both sections:—

Example 1.—Simple Cruciform Section.—If the height of the ribs at any point is made double the diameter y of the ideal conoid, we have in the third line of the table, first and last columns, the thickness of rib $b = 0{\cdot}07h$.

Example 2.—Suppose a core to be used and at any given place $h = 1{\cdot}5y$, and $k = 0{\cdot}6h$, we have according to line 8, columns 6 and 1, $b = 0{\cdot}12$ of the height h at the same place.

We may make b constant and determine k, or let k be constant and b vary. The latter case is shown in Fig. 415. Here the shanks are also cruciform in section, and the hub seats are made to receive keys, as shown in both sections, and the central one is strengthened by transverse ribs. A small auxiliary journal is shown at the end of the main journal, and is very useful in erection.

(*To be continued.*)



FIGS. 413 AND 414.

FIG. 415.

The Birmingham Association of Mechanical Engineers

A PARTY of members of the above association, numbering about 35, left Birmingham by the 7·30 a.m. train on Tuesday, 20th inst., on a visit to Crewe Works, by the kind permission of Mr. F. W. Webb. They were met at Crewe station by Mr. Oke, assistant manager, who had in waiting a special train which conveyed the party into the works. The method of steel making excited great interest among the gentlemen present, the process being explained in detail by Mr. Oke. The blowing engines were next examined, as were also the rolling mills, the arrangements being of the most perfect kind. About one o'clock an

adjournment was made to the Crewe Arms Hotel, where a substantial lunch was provided, at which the party were joined by Mr. Oke, Mr. Warnford, Mr. Saul, Mr. Howsin, and Mr. Ninis, all of whom had been most assiduous in their endeavours to make the visit as interesting and instructive as possible. After lunch, the president, Mr. A. Driver, in a few well-chosen remarks, moved a vote of thanks to Mr. Webb for his kindness in granting permission to visit the works, and also to Mr. Oke and his assistants for the courteous manner in which they had described the various objects of interest. The vote was unanimously carried, and in response Mr. Oke remarked that he would be pleased to transmit to Mr. Webb the vote so unanimously carried, and also expressed the pleasure which he and his assistants had experienced in conducting the party through the works. After lunch the inspection was continued by a visit to the forge, where the party were fortunate in seeing a large crankshaft being worked under a steam hammer. The foundry, fitting, and erecting shops were also visited.

The Design and Construction of Stationary Engines.—XXXVI.

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FIG. 172 shows another rod end, and also the crosshead end, and Tables XX. and XXI. give the leading dimensions, from actual practice, of a number of sizes more frequently employed in locomotive practice.

Fig. 176 shows a rod which is much used by some Lancashire makers, and is a very neat and secure form of rod for mill and factory engines. The brasses are adjusted, as in Fig. 174, by means of a sliding block and screw. The backs of the inner half-brasses are thickened up within the rod to correspond to the bevel of the sliding block, the taper of which is usually 3in. per foot. The sliding block is generally made of wrought iron, and of the full width of the rod end, so as to present a broad surface to the back of the brass.

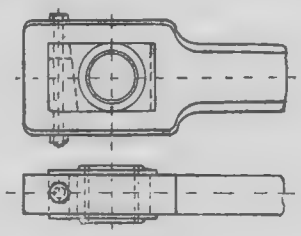


FIG. 174.

The flanges of the brasses top and bottom next the crank are cut away, so as to allow of their insertion into the rod end. The end flange being left on, prevents, when once in place, any chance of the brasses coming out. To withdraw the brasses the screw is taken out, the wrought-iron block removed, the back half of the brass moved back to clear the pin and then withdrawn, when the rod can be moved forward and the outer brass removed, this being done for both ends; the rod can then be readily removed. The proportional parts are given on the figure, from which the

TABLE XX.—CONNECTING ROD ENDS (CROSSHEAD END).

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	a	b	c
2⅜	4	3	1⅜	1⅜	1⅜	1½	3	¼	2⅜	2¼	⅜	2¼	1	⅜	1⅜	1⅜	3½	⅜	15⅛	8	1⅜	3⅛	1	5	⅜	1¼	2⅜	1¼
3	4½	3½	1½	2¼	3¼	1½	3½	⅛	2⅞	2½	⅜	2⅝	1	⅜	1½	1¼	4⅛	⅜	16⅜	9⅛	1⅜	3⅝	1¼	5	⅜	1¼	3	1¼
3⅛	5	4	1⅝	2⅛	2⅛	1⅝	4	⅜	3	3	⅜	2⅝	1⅛	⅜	1⅝	1⅜	4⅜	⅜	17⅛	9⅝	1⅝	4⅛	1⅛	5	⅜	1⅜	3⅛	1¼
3⅜	5⅛	4⅛	1⅝	2⅛	2⅝	2	4⅛	⅜	3⅜	3⅛	⅜	2⅞	1	⅜	1⅝	1⅜	4⅝	1	18⅛	10⅛	1⅝	4⅜	1⅛	5½	⅜	1⅜	3⅜	1¼
4	6	4½	1¾	2⅜	2⅝	2¼	4⅜	¼	3⅞	3½	⅜	3	1¼	⅜	1⅝	1½	5	1⅛	20	10⅞	1¾	4⅝	1⅛	5½	⅜	1⅜	4	1¼
4⅛	6⅛	5⅛	1¾	2⅜	2⅞	2⅜	4½	¼	4⅛	4	⅜	3⅛	1¼	⅜	1⅝	1½	5⅛	1⅛	20⅝	11	1¾	5⅛	1⅛	5⅝	⅜	1½	4⅛	1¼
4⅛	7	5⅛	1⅞	3⅛	3⅜	2⅜	5	¼	4⅜	4	⅜	3	1⅜	⅜	1⅝	1⅝	5⅛	1⅛	21	11⅜	2	5⅛	1⅛	5⅝	⅜	1¼	4⅜	1¼
4⅜	7	5⅛	2	3⅛	3⅛	2⅜	5	¼	4⅜	4⅛	⅜	3	1⅜	⅜	1⅝	1⅝	5⅜	1¼	21¼	12⅛	2	5⅜	1¼	5⅝	⅜	1¼	4⅜	1¼
5	7	5⅛	2	3⅛	3⅛	2⅜	5	¼	4⅜	4⅛	⅜	3	1⅜	⅜	1⅝	1⅝	5⅜	1¼	21⅞	12⅛	2	5⅜	1¼	5⅝	⅜	1¼	5	1¼
5⅛	8	6⅛	2⅛	3⅛	3⅛	2⅜	5⅛	¼	4⅜	4⅛	1	3	1½	1½	2⅛	1⅜	6	1⅜	23⅛	13	2⅛	6⅛	1⅛	5⅞	1⅜	2	5⅛	1½
5⅜	8⅛	6⅜	2⅜	3⅜	3⅜	2⅜	5⅜	¼	4⅜	4⅜	1	3	1½	1½	2⅜	1⅜	6⅛	1⅜	22⅛	13	2	6⅛	1⅛	5⅞	1½	2	5⅜	1½

TABLE XXI.—CONNECTING ROD ENDS (CRANK PIN END).

A	B	C	D	E	F	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	a	e
3	4	3	4	3⅜	1½	1⅛	⅝	1½	1⅜	1⅛	2⅛	⅜	1⅜	1⅛	1	2⅛	⅜	4⅛	⅜	2⅛	6	⅜	1	15	1⅜	1⅝
3⅛	4⅛	3⅛	4	4	1⅛	1⅛	⅝	1⅜	1⅜	1⅛	2⅛	⅜	1⅜	1⅛	1	2⅛	⅜	4⅛	⅜	3	6	⅜	1⅛	15⅝	1⅛	1⅝
3½	5	4	4	4⅛	1⅛	1⅛	⅝	1⅜	1⅜	1⅛	2⅛	⅜	1⅝	1¼	1	2⅛	⅜	4⅛	⅜	3⅛	6	⅜	1⅛	16	1⅛	1⅝
3⅝	5	4	4	4⅛	1⅛	1⅛	⅝	1⅜	1⅜	1⅛	2⅛	⅜	2	1⅛	1	2⅛	⅜	4⅛	⅜	3⅛	6⅛	⅜	1⅛	16⅛	1⅛	1⅝
4	6	4½	4⅜	4⅜	1⅜	1⅛	⅝	1⅜	1½	1⅜	2⅛	1	2⅛	1⅛	1⅛	2⅛	⅜	5⅛	1	3⅛	6⅛	1	1⅛	16⅛	1⅛	1⅝
4⅛	6	4½	5⅛	5⅛	1⅜	1⅛	⅝	1⅜	1⅝	1⅜	2⅜	1	2⅛	1⅛	1⅛	3	⅜	5⅛	1	3⅛	6⅛	1	1⅛	17⅛	1⅛	1⅝
4⅛	6⅛	5	5⅛	5⅛	1⅜	1⅛	⅝	2	1⅝	1⅜	3	1	2⅛	1⅛	1⅛	3⅛	⅜	5⅝	1	4	6⅜	1	1⅛	18⅛	1⅛	1⅝
4⅜	6⅝	5⅛	6	5⅝	2	1⅛	⅝	2⅛	1⅝	1⅜	3⅛	1⅛	2⅜	1⅛	1⅛	3⅜	⅜	6	1	4⅛	7	1	1⅛	19	2	2⅛
5	7	5⅛	6⅛	6	2	1⅛	⅝	2⅛	1⅝	1⅜	3⅛	1⅛	2⅜	1⅜	1⅛	4	⅜	6⅛	1⅛	4⅛	7⅛	1⅛	1⅛	21	2⅛	2⅛
5⅛	7	5⅛	6⅜	6⅛	2⅛	1⅛	⅝	2⅛	1⅝	1⅜	3⅛	1⅛	2⅜	1⅜	1⅛	4	⅜	6⅛	1⅛	4⅛	7⅛	1⅛	1⅛	21⅛	2⅛	2⅛
5⅛	7	5⅛	6⅜	6⅛	2⅛	1⅛	⅝	2⅛	2	1⅜	3⅛	1⅛	2⅜	1⅜	1⅛	4	7	1⅛	2	4⅛	7⅛	1⅛	2	22⅛	2⅛	2⅛
5⅜	7⅛	5⅛	6⅜	6⅜	2⅛	1⅛	⅝	2⅛	2	1⅜	3⅛	1⅛	2⅜	1⅜	1⅛	4	7	1⅛	2	4⅛	7	1⅛	2	22⅛	2⅛	2⅛
6	7⅛	5⅛	7	7⅛	2⅛	1⅛	1	2⅛	2⅛	1⅜	3⅛	1⅛	2⅜	1⅜	1⅛	4	7	1⅛	2	5	7	1⅛	2	22⅛	2⅛	2⅛
6⅛	8⅛	6	7⅛	7⅛	2⅛	1⅛	1	2⅛	2⅛	1⅜	3⅛	1⅛	2⅜	1⅜	1⅛	4	7	1⅛	2	5⅛	7	1⅛	2	25	2⅛	2⅛
6⅛	8⅛	6⅛	7⅛	7⅛	2⅛	1⅛	1 1/16	3	2⅜	2	3⅛	1⅛	2⅜	1⅜	1⅛	4⅛	7	1⅛	1	5⅛	7⅛	1⅛	2	23⅛	2⅛	2 1/16
7	9	6⅛	7⅛	8⅛	2⅛	1⅛	1⅛	3	2⅛	2	3⅛	1⅛	2⅛	1⅜	1⅛	4⅛	7	1⅛	1	5⅛	7⅛	1⅛	2	25	2⅛	2⅛

suitable for steam pressures from 60lb. to 100lb. per square inch.

In such rods it is better practice to introduce a wrought-iron block behind the brass for the cotter to bear against, as in Fig. 173, which shows a large rod end of this type, it being the crankpin end for Fig. 165.

Figs. 174 and 175 are modifications of the solid-ended rod, the latter example being

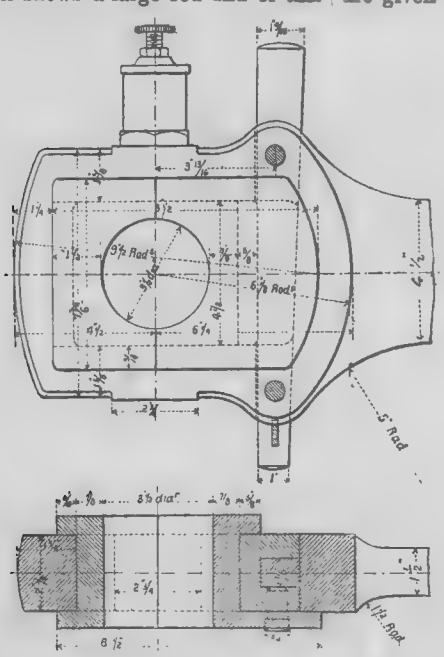


FIG. 175.

various dimensions for any size of rod can be got with fairly approximate correctness.

(To be continued.)

The Electric Transmission of Power.

(Continued from page 122.)

ENGINEERS are not yet agreed as to whether high or low-speed engines are preferable for power stations, but the weight of opinion seems to be in favour of slow speed. High-speed engines with direct belting give one engine to one, two, or sometimes three and even four generators—independent units which can be shut down or started, one after another, to meet the demands on the station, and permit of multiplication of units so that a breakdown of one unit, either steam or electrical, only throws out of service a small fraction of the station capacity. Against this lies the fact that injury to the engine throws out the dynamos, as well as *vice versâ*. With large, slow-speed engines, and countershafting, any dynamo or group of dynamos can be run from any engine. Against the greater coal economy of the slow-speed engine is to be urged the loss of power in the countershaft and belting. Of late the method of direct coupling, making the engine and dynamo practically one machine, is meeting with more favour, and for large-sized generators this method undoubtedly has a future. The engine and dynamo are mounted on the same shaft.

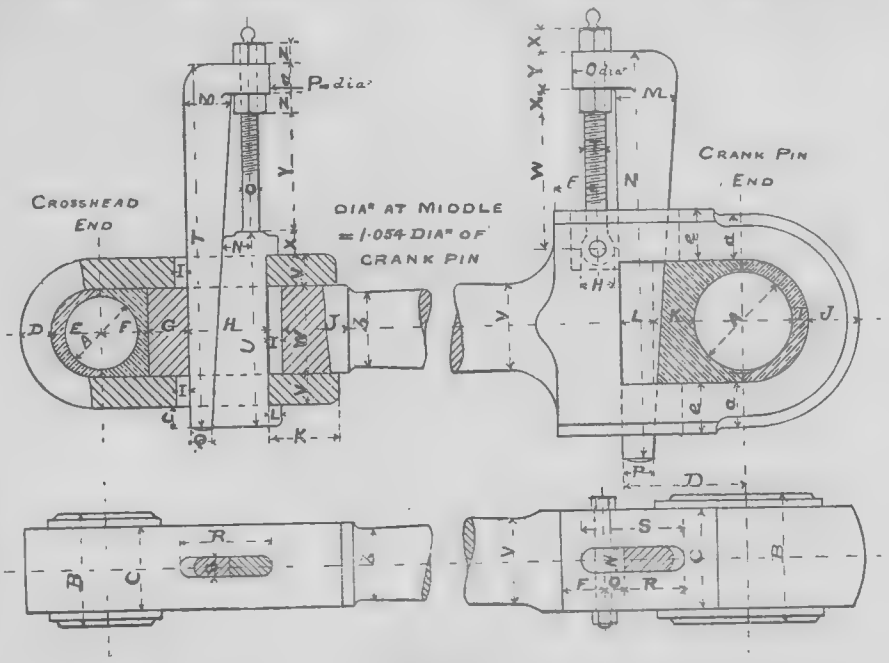


FIG. 172.

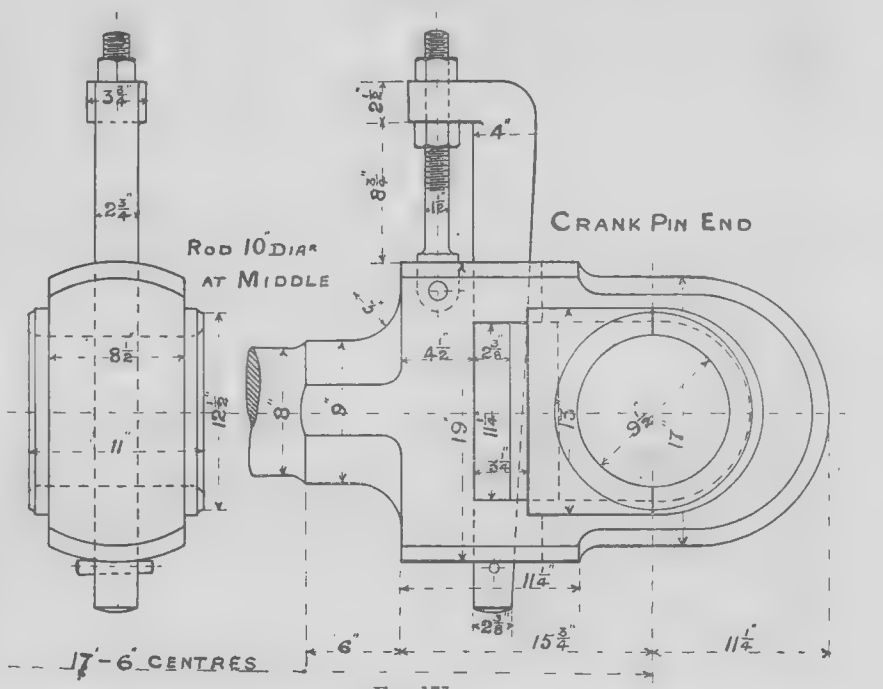


FIG. 173.

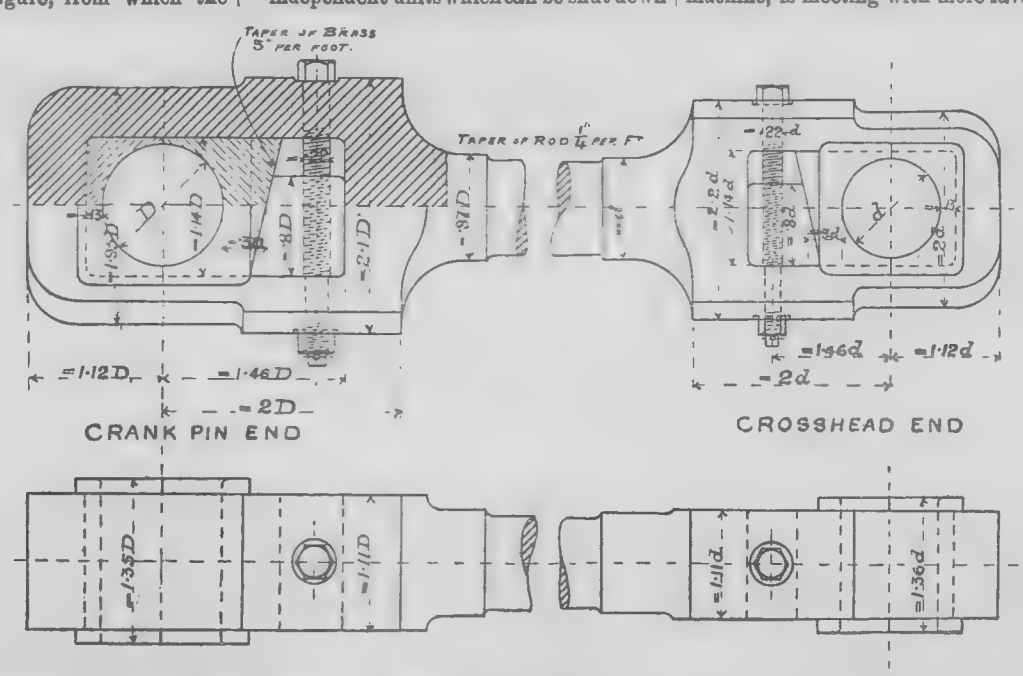


FIG. 176.

The latest types of dynamo are built to run with slow armature speed, and in this respect the electrical manufacturers are gradually approaching the engine makers.

Uniform armature speed is essential to maintenance of constant potential, and the engines should have perfect governors. Many faults attributed to the electrical apparatus have been found on investigation to be really due to poor engines, imperfect governors, slipping belts, low steam pressure, or other cause remote from the electrical apparatus.

Engines work most economically under full load. Unfortunately, constant loads are not the rule in electrical work, and as the loads vary the mean must be somewhat below full load. A mean of several electric railway power stations shows the average load to be about 60 per cent. of the maximum, and in lighting stations running for 24 hours the changes are, of course, much greater. In the latter case it is imperative that the steam plant be divided into numerous units which can be gradually brought into service according to the demands. Arc lighting work is fairly constant. Street lights burn all night or on moonlight schedules, and are all started and stopped at the same time. Commercial lights may burn till m dnight. The limitations are known and can be provided for. Incandescent work, particularly with meters, is more variable. It follows that as the average output is well below the maximum, the engines are not working to the best advantage, and the greatest coal economy is not attainable. In Europe, this is obviated to some extent by adding a storage battery to the station equipment. The steam plant is then proportioned to the mean demand for power, and runs constantly at full load. When the demand for power falls below this mean, the extra current generated is directed into the storage battery. When the demand exceeds the capacity of the engines and dynamos, the extra current is supplied from the batteries. The cost and maintenance of the batteries in t his method must be balanced against the cost and maintenance of the extra steam and generator plant in the first method, and the less economical operation. It is a striking fact that storage batteries are used to a very large extent in foreign stations (not necessarily in all cases in the way above indicated), and rarely, if at all, used in this country. One would suppose that the actual results would long since have determined in which method true economy is to be found, but so far the engineers on the two sides of the Atlantic have not been able to agree. The practice differs also in another respect. In Europe rope belting is largely used, while in this country it is rarely found and has been condemned in one or two places where it has apparently had a fair trial.

(2.) *The Generator.*—The kind of generator used depends upon the method of utilising the electrical energy produced.

The arc-lighting dynamo is made to generate a current of constant quantity and potential varying with the number of lamps on the machine. The incandescent direct-current dynamo generates a current of constant potential and quantity varying with the number of lights. The railway or ordinary power generator is similar to the incandescent direct-current machine. The alternating-current dynamo produces a current suitable for incandescent lighting, but so far it has not been made available for power work, as the alternating motor has little torque, and therefore cannot start under a load. The pulsating direct-current machine is the ordinary direct incandescent dynamo with a third brush added, and is used as before stated. The three-phase current dynamo has no commutator, runs noiselessly, and can be used for power purposes, as the motor has sufficient torque to start with a load.

In the synchronous method of transmitting power by alternating currents, it is necessary to start the motor by some exterior power; but if proper arrangements are made, the starting is no more difficult or tedious an operation than the starting of a large Corliss steam plant.

The synchronous motor when overloaded "lies down" and declines to do any work at all until the load is reduced to proper limits.

The synchronous alternating motor has an excellent quality, in which it is only equalled by the plain shunt-wound motor of the every-day electric-lighting station. It regulates perfectly as to speed, keeping in step, within the limits of its capacity, with the generator which drives it.

The non-synchronous type of motor, in connection with the three-phase current, presents many features of superiority over the synchronous, in that its speed will not vary more than a few per cent. from light to full load, and also from the fact that it will start under full load, and requires no exciting current. A field is set up by three conductors conveying currents of three-phase character, in a laminated iron mass, which field is made to rotate, and drags around a movable iron armature on which is a system of closed coils, or coils which can be closed, these coils having strong currents induced in them by the moving lines of the field. Thus, the rotating magnetic lines, in cutting the armature conductor, push the conductor along by virtue of the reaction of opposing currents set up in the conductors of the armature, or closed circuits. These motors are not capable of being used as generators when revolved by exterior power. The great advantages of this method are that the motors can be started and stopped at will, and have no commutators.

The sizes of the dynamos have greatly increased in the last three years. We have now 70-light arc dynamos, 2800-light direct incandescent machines; Ferranti's 100,000, 16C P. light alternating (10,000 H.P.) dynamos; and 670H.P. generators for power use.

The Thomson-Houston Company are now building 16 of these large power dynamos for the West End Street Railway of Boston.

In increasing the sizes of dynamos a change from the bi-polar type of the smaller dynamos has been found necessary, and the large machines are made with not less than four poles. Slower speed of the armature is a natural advantage, and many other improvements are to be found in the latest type of power dynamos.

The size of the dynamo should be proportioned to the total work at the station. There should never be less than two generator units, and, preferably, more. With a total of 250H.P., it would be poor practice to have but one 250H.P. dynamo. Three eighties would be far preferable. With a total of 2000H.P., it would be poor practice to have twenty-five 80H.P. dynamos. Eight 250's would be preferable

The switchboard should be provided with every possible safety device to automatically prevent overloading of the dynamos, injury to the machines from lightning, and to automatically throw off the current in case of short circuit on the line resulting from crosses with the line wires or accidents of such nature.

(*To be continued.*)

Shipbuilding Notes.

The third-class cruiser "Satellite," which has been thoroughly overhauled and repaired at Sheerness Dockyard, was subjected to a full-power trial of her engines and boilers at Sheerness on the 19th inst. The results were satisfactory, and the cruiser was ordered to proceed to sea for her official gunnery trials.

Messrs. Russell and Co., Greenock, launched a steel sailing ship of 1500 tons register and 2500 tons capacity, on the 21st inst. Her dimensions are:—245ft. by 37½ft. by 22½ft. This firm has bought a 1300-ton ship on the stocks in Messrs. Biggar and Co's yard at Londonderry. She will be finished there, and subsequently brought to Greenock to fit out.

There was launched, on the 22nd inst., from the yard of the Tyne Iron Shipbuilding Company Limited, of Willington Quay-on-Tyne, a steel screw steamer of the following dimensions:—Length, 248ft.; breadth, 34ft.; depth, 23ft. 4in., moulded. The engines, which are to be supplied by Messrs. Wigham, Richardson and Co., of Neptune Works, Newcastle, are of the triple-expansion type.

On the 21st inst. Messrs. Richardson, Duck and Co. launched, from their yard at South Stockton, a steel screw steamer of the following dimensions:—Length over all, 293ft.; breadth extreme, 37ft. 6in.; depth moulded, 20ft. 4in.; gross tonnage, about 2190 tons. Her engines are by Messrs. Blair and Co. Limited, having cylinders 21in., 35in., and 57in. diameter, by 39in. stroke.

Messrs. Sir W. G. Armstrong, Mitchell and Co. launched, on the 20th inst., from their Walker shipyard, a petroleum steamer. She has been constructed on Swan's system, for the carriage of petroleum in bulk. The dimensions are:—305ft. long, 39ft. beam, and 26ft. 6in. deep. She will be capable of carrying 3400 tons on a moderate draught. After the launch she was taken to the works of the Wallsend Slipway and Engineering Company Limited, where she will be fitted with triple-expansion engines.

On the 17th instant the steel screw steamer "The Southern Cross," built by Messrs. Workman and Clark Limited, Belfast, went on her trial trip. The dimensions are:—400·4ft. long, 48·1ft. broad, 33·65ft. deep, gross tonnage 5049. She will carry a deadweight cargo of 7300 tons. The triple-expansion engines of 2900H.P. have cylinders 29in., 46in., and 75in. diameter, by 54in. stroke. Steam is supplied from three double-ended multitubular boilers at a pressure of 170lb. per sq. in. On trial, a speed of 13¼ knots per hour was attained.

Modern Systems of Refrigeration in Ships.

(*Concluded from page* 123.)

ANOTHER well-known system of refrigeration is that adopted by Messrs. J. and E. Hall, of Dartford, whose firm has been established for the last 106 years, and who have kindly supplied much information. The machines are of the "patent carbonic anhydride refrigerating" description, and are employed for all purposes where a low temperature is required, and owing to their efficiency, compactness, and safety, are particularly adapted for the manufacture of ice, for meat-freezing establishments, for the importation and storage of chilled meat, and for preserving passengers' provisions, and making ice on board ship, etc., etc.

Among their special advantages may be mentioned the great reduction of power required and coal consumption, absence of danger from leakage, simplicity of arrangement, and great strength of parts. By means of a compressor and liquefier. the carbonic anhydride used in these machines may be collected from the fermentation tuns of breweries and distilleries, and is supplied ready for use in steel cylinders about 4ft long and 6in in diameter. The m chines consist of three leading parts, as follow:—(1) The compressor, by means of which the gas drawn from the refrigerator is compressed; (2) the condenser, in which the compressed warm gas is cooled and liquefied by the action of water; and (3) the refrigerator, in which the liq id carbonic anhydride is caused to evaporate, thus producing any degree of temperature that may be required down to 50° below zero.

The charge of the anhydride originally put into the machine is repeatedly and progressively passed through the above processes of compression, condensation, and evaporation, hence a small quantity only of this gas is required to be added from time to time to replace any small losses. When these machines are used for *producing ice* a tank is supplied containing brine, which is cooled by the evaporation of liquid anhydride within the coils of the refrigerator. A large number of galvanised steel moulds containing the water to be frozen are immersed in the brine, thus producing blocks of clear transparent ice of any required size. In large establishments overhead travelling cranes are employed, by means of which the rows of moulds are raised out of the tanks, and the blocks of ice, after being detached by thawing, are conveyed either to the ice store or otherwise delivered.

Messrs. Hall's machines are worked by compound engines having a surface condenser between them, as supplied to the s.s. "Highland Mary," "Highland Glen," and others of the clan belonging to Messrs. James Nelson and Sons, of the Free Trade Meat Company, London and Liverpool. In these, and many other vessels, the compressors are placed in a line with the steam cylinders, each of which delivers its gas into an independent condenser contained in the base of the machine, in which the carbonic anhydride is changed into the liquid form. In connection with each condenser there is a separate refrigerator consisting of coils of wrought iron pipes, in which the above evaporates and produces intense cold. These coils are contained in a steel casing, in which the brine is circulated.

The two machines are so arranged that either the entire plant can be worked, or, if desired, one of the compressors with its condenser and refrigerator can be disconnected, when the other compressor can be worked by itself. This type of machinery has been designed to meet the limited space on board ship, and is capable in the largest sizes of preserving 80,000 frozen sheep, and occupying a space not exceeding 6ft. 6in. in height.

For large cargoes the carcases of meat are frozen on shore, and after being brought on board perfectly hard and rigid are stacked "in bulk" in the holds, which are specially insulated by double wooden walls filled with flake charcoal. The cold air is discharged through openings along a central trunk, and after percolating through the rows of carcases it is drawn back to the machine through trunks at the sides of the vessel. For ships' provision chambers the meat is usually put on board freshly killed, and is in such cases frozen by the machine. The cold air is also used for making ice, for cooling the drinking water, wines, etc., and for preserving fruit, vegetables and butter, at moderate temperatures. It can also be mixed with external air for supplying a fresh cooled atmosphere to the saloons and cabins.

As the cold storage of meat previous to being put on board, and also after it has been landed from the vessel, is another most important part of the scheme, it may here be stated that the buildings in which these operations are conducted have hollow interior walls, and also similar floors consisting of steel plates, placed a few inches apart, and between which the brine cooled by the carbonic anhydride machine is allowed to circulate. In the passages between these walls the meat is hung, and the low temperature at which the walls are kept causes the heat to radiate from the meat, which becomes rapidly frozen.

In large works the carcases are hung on hooks connected together, forming a continuous chain, which is set in motion by gearing. In this way they require no handling until they arrive at the end of the building ready for despatch. The rapidity of all-round manipulation by this patent method of Messrs. Hall's is very considerable, consequently the space set apart for the freezing-rooms is much reduced, and therefore the buildings are less costly; it moreover effects a great saving of labour. The stores containing the meat are maintained at a temperature of about 10 degrees for freezing, and from 30 degrees to 32 degrees for chilling purposes, either by the circulation of large volumes of cold dry air, which are cooled in the engine-room, or by means of the circulation of brine, cooled by the machine, contained in wrought-iron pipes placed underneath the ceiling of the cold chamber, according to circumstances.

In the year 1868, Mr —now Sir—A. Seale Haslam commenced business for himself in the Union Foundry, at Derby. Previous to this, however, he had acquired much practical experience in the works of the Midland Railway Company in the same locality. and also in those of Sir W. G. Armstrong and Co., where he had much to do with hydraulic machinery. A few years after starting on his own account he applied himself to the practical development of a theory which had been talked about for 150 years, and with this in view he endeavoured to design an apparatus capable of producing the cool chambers necessary for the transhipment of fresh food from distant ports.

The fact upon which he based his numerous experiments was this:—Air which has been compressed, dried, and cooled will, if suddenly allowed to expand, fall in temperature to a degree below the freezing point corresponding to the density of the compression. After many difficulties had been overcome, the object of the inventor was attained, and Mr. Haslam evolved the dry air refrigerating machinery with which his name has for many years past been associated. One of the first of his machines was put on board the s.s. "Orient," which arrived in London in 1881 with a cargo of beef and mutton that had been brought from Sydney in the most perfect condition.

No sooner did this fact become known and its principles established, than numerous other leading steamship companies adopted similar machinery for the same purpose, and as a proof of the rapidity with which the system was adopted it may be mentioned that while in the above year only about 20,000 frozen carcases were brought to England, this number was increased to upwards of 2,000,000 in 1891, through the increased popularity of the Haslam machines. The company of which this gentleman is the managing director have become the proprietors of the Bell-Coleman system of refrigeration, and are now the sole makers of both types of machinery.

When the "Orient" made her first voyage with a cargo of meat from Australia, the event created quite a sensation in both hemispheres, as an outlet was found for a new trade which would greatly benefit many millions of people. Commerce, perhaps, is never more beneficently employed than when engaged in transferring the redundant food products of one country to the shores of another, where they are greatly needed. And mechanical science never appears in a better light than when it enables this to be accomplished with efficiency and economy, as it has now done in a very remarkable manner.

In Australia, Canada, South America, and other distant lands, vast herds of cattle and flocks of sheep are comparatively worthless as food for the inhabitants, owing to their scanty numbers. In the British Isles, on the other hand, the population is enormous and the native food supply extremely limited. Hence the question naturally enough arose, How can the waste products of one or more countries be made to benefit exporters and importers alike, as well as vast communities to whom they would be highly beneficial?

For a long time no solution of this problem could be found, until a successful adoption of *mechanical refrigeration* removed every difficulty and opened out a

highway of commerce hitherto unknown, not only for the importation of meat, but for fruits and vegetables in large quantities, and indeed anything else of a perishable nature that could be preserved in a frozen state during a long voyage.

There is a very peculiar law of nature that alone affects water, which everyone may not quite comprehend in its wide sweeping and all-important significance, and to which we may here refer. The application of heat to this fluid when at 32 degrees causes it unnaturally to contract until 39 degrees are reached; after this, however, expansion sets in in the usual way. Conversely, water *expands* when cooled down from 39 degrees to freezing point, and hence ice *floats* on the surface; were it otherwise, our beautiful isles and all their surroundings, not to mention the northern parts of Europe, Asia, and America, would ages ago have become bleak, sterile, uninhabited and uninhabitable frozen-up wildernesses, simply because the ice of former years had sunk by degrees to the bottom of lakes, rivers and seas, and made them solid throughout. All this, however, has been happily prevented by the strange and most beneficial subversion of a natural law, which we believe is nowhere else to be found, but which, in connection with the subject of refrigeration on the grandest scale, is worthy of note.

The system has been most extensively applied to cold storage establishments both at home and abroad, and this, as will be seen, is an absolute necessity, so that meat in a hot climate may be preserved in good order before being taken on board a ship. The Australian Frozen Meat Company, for example, kill and freeze all their animals until ready for transference to a vessel in lighters or otherwise; the carcases are then placed in the refrigerating holds, where they soon recover from the temporary thaw caused by transport to the vessel. It is at Deptford, however, where perhaps the largest and most complete installation in the world for chilling purposes alone is to be found, the construction of which was carried out by the Haslam Company in 1889, with the object of enabling London to possess a plant sufficiently extensive for suitably preparing the immense arrivals of foreign meat even in the hottest weather. So successfully has the machinery worked, that last year extensions had to be made by the same firm to meet the growing demand for foreign live cattle, which are now landed in such enormous numbers.

After the animals are killed in one part of the premises, the still warm sides can be automatically carried into the chilling departments by means of overhead rails, from which hooks are suspended; after remaining there about twenty hours, they are removed to make room for another quantity of about 800 sides, which, in turn, are cut up and sent to market.

The engines for working the establishment are of the compound description, and the boilers are of the Babcock-Wilcox type, and whilst the original refrigerating machine had a 70,000ft. capacity, the new one has 150,000ft., or at least double the power.

The process involves the compression, cooling, and subsequent expansion of atmospheric air, no chemicals whatever being used, as the sole agents consist of air and water. The air is compressed to about 50lb. pressure per square inch, and the heat thus generated is removed in a special cooling apparatus. It then passes to the patent "drying pipes," which are placed in one of the compartments of the chill-room, and from these it returns to the expansion cylinders, in which it expands, pressing forward the pistons, and so helping to drive the machine, and in virtue of the work thus done it becomes cooled. The air, upon being liberated from the expansion cylinders at a temperature ranging from 100° to 120° below freezing point, is led by wooden trunks or ducts into the chamber, to the various compartments of which it is conveyed by further trunks, which are provided with sliding doors at intervals, so that the quantity of air admitted to any particular department can be regulated according to the temperature required, which varies from 328° to 368°. The insulation is carried out by an improved system of charcoal lining, the fitting up of the rooms with the necessary ventilating trunks and doorways for the prompt entry and exit of the meat being in every way all that could be desired.

The success of all engineering schemes, even of the greatest magnitude, depends upon the following primary considerations:—In the first place, find out exactly what has to be done; secondly, ascertain the best methods of doing it, and then prove satisfactorily that the undertaking will pay. So far, however, as the subject of our remarks is concerned, we have reason to believe that the mechanical part of the business has been most admirably performed, and that sufficient has been said to show that at home and abroad the refrigeration scheme was so greatly needed that its commercial prosperity has now been assured.

Judging by the records of the three firms already noted, we can only conclude that although their practice somewhat differs in detail, every one of them has supplied ships, etc., with an enormous number of cold air machines—so enormous, indeed, as to show clearly the very high appreciation of their efforts by the public, which must be very gratifying to all of them.

New Type of Accumulator for Traction Work.*

THE author describes the various properties which a good type of cell ought to possess, and remarks that such cells are subjected to very rough usage in traction work. They should be able to discharge very large currents, and should be as light as possible. The new cells differ in many respects from those most in use in this country. Long thin channels of celluloid are used as supporting frames. The cross section of the channels is approximately one-third of a circle. The active material consists of peroxide of lead, and it is pressed into solid short cylinders as hard as the carbon for arc lamps; each cylinder has a hole along its axis, and they are all "formed" before being placed in position. They are then coated with a special conducting cement, and laid at a short distance apart inside two channel-shaped strips of sheet lead, each of which is provided with a wide lug at one end. Each set of five cylinders, with the lead conducting strips, are then placed inside a pair of celluloid channels. About eight of these complete sets are then mounted vertically, and held together by bands of celluloid. Celluloid tubes also pass through holes at each end of the celluloid channels. The whole is held firmly together by wooden wedges. All the lead strips are then soldered on to one common bar, and the compounds form either the positive or negative plate in a cell. It is claimed that the construction is solid, and that only the thin lead conductors on the positive plates deteriorate, and can easily be renewed.

Notices of New Books.

A GUIDE TO ELECTRIC LIGHTING FOR THE USE OF HOUSEHOLDERS AND AMATEURS. By S. R. BOTTONE. London: Whittaker and Co. 1s.

MR. BOTTONE, who is well known as the author of several small works on electrical subjects, has in this book endeavoured to afford the amateur and general reader an insight into the general principles of electric lighting. In the first chapter the various types of voltaic batteries are described, while in the second chapter illustrations of several of the most commonly used dynamos are given. Chapter III. deals with lamps; Chapter IV. with accumulators; Chapter V. with switches, lamp-holders, cut-outs, ammeters, etc.; Chapter VI. with electric motors; Chapter VII., transformers; and Chapters VIII. and IX. with the cost of electric lighting and electric power. The book contains much information that is at present in demand by the lay reader, and as it is written in a succinct style it should prove of value to those who are contemplating installing the electric light, and generally to all who desire to become acquainted with the elementary principles of electric illumination.

PRINCIPLES AND PRACTICE OF PLUMBING. By S. STEVENS HELLYER. London: G. Bell and Sons. 5s.

THIS is an excellent handbook on plumbing, based upon a thoroughly practical acquaintance with the subject, and therefore calculated to be of the greatest possible service to workers in lead, and plumbers generally. Chapters are given on lead, tin, and alloys, soldering apparatus, etc., while to the subject of lead laying nine chapters are devoted. There are also sections on joint making, plumbers' traps, lining cisterns, pipe fixing, soil pipes, water-closets, baths, lavatories, water storage, house drains, etc. From the foregoing brief epitome of the contents of this work it will be seen that the ground covered is very extensive; but each division receives careful treatment, and is dealt with as exhaustively as can be expected in a work of this description. We have no hesitation in recommending this work to the notice of those who require a thoroughly practical treatise on the subject.

* Inst. C.E.: Foreign Abstracts.

SAFETY VALVES: THEIR HISTORY, ANTECEDENTS, INVENTION, AND CALCULATION. By W. BARNET LE VAN. New York: N. W. Henley and Co. London: E. and F. N. Spon.

IN this work the author has collected from various treatises, scientific periodicals, and other less accessible sources, a deal of information on the subject of safety valves. All the best-known forms of valves are illustrated and their operation described, while the author has also included a number of rules and formulæ from various sources, including the results of tests of valves made from time to time. Compilations of this kind are generally of a patchwork character, and the present work is no exception to the rule. Moreover, Mr. Le Van himself appears to have not altogether mastered some elementary principles. Thus, on the first page of the book we find this statement: "The area of a valve increases *nearly* as the square of its diameter; the circumference directly as the diameter." Again, on page 14 we find: "The product of a force multiplied by its lever is called *static momentum*." What the author means by these definitions is not very clear. Much of what is presumably intended for humour is introduced towards the end of the book; but we certainly fail to see the object of devoting four pages, including two sketches, to a descriptive narrative of "How the devil got into the boiler and out again." The work is printed very indifferently and on bad paper, and in several instances the pages are numbered on the wrong side. We have become so accustomed to high-class typographical productions from America, that the shortcomings of the present work are rendered the more conspicuous.

ELECTRIC-LIGHT CABLES AND THE DISTRIBUTION OF ELECTRICITY. By STUART A. RUSSELL. London: Whittaker and Co., and G. Bell and Sons.

THIS is a useful addition to the number of capital works which Messrs. Whittaker have published in their "Specialists'" series. In the present treatise the object of the author has been to present descriptions of the various systems of electrical distribution and types of cable now in use. It may be safely said that almost every description of cable will be found described in this work. But its greatest value will be found in connection with the problems pertaining to the economical distribution of electricity. The various systems of carrying conductors, the determination of their area and insulation, testing, etc.; the heating effect of the current, different conduit systems, etc., are fully explained by Mr. Russell. A large number of illustrations are scattered throughout the work, but many of these are not up to the usual standard.

THE OPTICS OF PHOTOGRAPHY AND PHOTOGRAPHIC LENSES. By J. TRAIL TAYLOR. London: Whittaker and Co. 3s. 6d.

THIS is a capital little treatise on photographic lenses, by Mr. J. Trail Taylor, who is the editor of the "British Journal of Photography." Some of the earlier chapters are on the nature and properties of light, but the greater portion of the work consists of practical information regarding the various types of lenses, methods of testing, grinding, etc. Users of photographic lenses have in this little work an exceedingly useful handbook.

ELECTRICAL INSTRUMENT MAKING FOR AMATEURS. By S. R. BOTTONE. Fifth Edition. London: Whittaker and Co. 3s.

WE have on a previous occasion expressed our favourable opinion of this work, and we need now only say that in this, the fifth edition of the work, a few simple instructions for making a small arc lamp, an incandescent lamp, a current reverser, etc., have been included.

Trade Notes.

The Stanton Ironworks Company have secured an order for the supply of iron pipes to the Heywood Water Committee.

Messrs. Charles Cammell and Co., Sheffield, have obtained a contract for 4700 tons of steel rails for the Blyth and Gladstone Railway, South Australia.

The John Cockerill Company, of Liege, Belgium, have received an order for 5000 tons of steel rails from the Congo Railway Company.

Messrs. J. Jessop and Son, of Leicester, have just completed a 35-ton travelling crane for a Russian firm.

Messrs Lucas and Aird, Glasgow, have secured the contract for the new wet and graving docks at Southampton.

Messrs. Aveling and Porter, of Rochester, are supplying a second steam roller to the Godalming Highway Board.

Messrs. Handyside and Co., of Derby, have obtained a large order for ironwork for the Tottenham and Forest Gate Railway.

The Nyland Engineering Company at Christiania have received an order for two locomotives from the Norwegian State Railways.

The Barrowfield Iron Company, Glasgow, are completing a new gasholder at Bothwell. It is of the usual lift type, and measures 80ft. in diameter.

Messrs. Brown and Bovery, of Baden, Switzerland, are constructing a large electric locomotive. It will carry dynamos of from 1500 to 2000H.P.

The North German Lloyd Company have contracted with Messrs. Möller and Hollberg, of Stettin, for the construction of a steamer of 1500 tons carrying capacity.

Messrs. Priestman Brothers, of Hull, have undertaken the manufacture of the McGlasson reversible screw propeller, and will shortly be able to supply them to intending users.

The Barrow Hematite Steel Company have booked an order from Australia for 13,000 tons of 65lb. steel rails and 10,000 tons of 45lb. steel rails, and also an order for 900 tons from New Zealand.

Mr. W. S. Dougall, Radcliffe-on-Trent, has been awarded a silver medal at the Dublin Distillers' and Brewers' Exhibition, for his improved system of driving machinery by papier-mache-covered pulleys.

Messrs. J. E. H. Gordon and Co. Limited, London, have obtained a contract for the electric lighting of Coatbridge, and are proceeding to erect a station of 9000 lights capacity with all the necessary street mains.

The Spanish Minister of Marine is inviting tenders until the 14th of December for the construction of a set of triple-expansion engines of 15,000H.P., for a cruiser of 7000 tons for the Spanish navy.

The contract for the hydraulic hoists and relative machinery for working the Glasgow Harbour tunnels has, it is stated, been secured by the American Elevator Company, Messrs. Otis Brothers and Co., of New York, where the machinery is to be made.

Mr. Wasteneys Smith, of Newcastle-on-Tyne, has just completed anchors of his well-known stockless patent for the recently-launched Cunard liner "Campania" and her sister ship "Lucania," weighing nearly 6½ tons each, being the largest stockless anchors in the world, and tested to the highest proof strain that can be given by Lloyd's machines.

The Corporation of Burnley are inviting tenders for the supply and erection of machinery for their central electric station, and for cables in the streets, as a whole or in parts in eight divisions, as follows:—Boilers, fuel economisers, engines, travelling cranes, dynamos, accumulators, switchboards, cables. Specifications, forms of tender, and other information may be obtained from Mr. J. P. Leather, Gasworks, Burnley, and the tenders are to be sent in by October 26.

Mr. John Spencer, Globe Tube Works, Wednesbury, has purchased the whole of the pump patterns of Mrs. Eliza Tinsley, Great Bridge, and is now making all kinds of brass and iron lift, force, and hand pumps. Mr. Spencer has now got his new mill for making lap-welded steel and iron tubes fully at work, and is turning out boiler tubes, water mains, artesian well tubes up to 8in. in diameter, telegraph poles, and all kinds of tubes used in connection with the transmission of electrical power, in addition to his steel tubes with flanges welded on.

The Globe Engineering Company, 38, Victoria Buildings, Manchester, has been formed to acquire from Mr. A. G. Brown, of Bolton, the patents and rights of manufacture and sale of the Globe simple and compound engines, Globe safety boilers, and water and steam separators. The Globe engines are well and favourably known throughout Great Britain and the Continent, and during the last four years they have been applied to a variety of purposes, including electric lighting, woodworking machinery, cotton machinery, rotary pumps, sugar-cane mills, etc. The company will also acquire the agency for the sale throughout Europe of the well-known Tabor indicator, the Tabor revolution counter, the Coffin averaging instrument, and the Ashcroft safety valves. Mr. Brown, who has undertaken to act as managing director for the first five years, enjoys an exceptionally high reputation as a mechanical engineer, both in this country and America, and under his energetic management the company has undoubtedly every prospect of developing into a highly successful concern.

Wheel cutter in metal only. Every description of gearing. R. CHIDLAW, 43, City-road, Manchester.

Having regard to the enormous circulation of THE MECHANICAL WORLD, the Editor suggests that it is by far the best medium for the insertion of every kind of "Wanted" advertisement, and the price is only one halfpenny per word. The Editor will be glad if MECHANICAL WORLD readers will kindly bear this in mind as occasion arises.

On Electroplating Cast Iron with Aluminium.*

THE new City Hall at Philadelphia, now nearly completed, has a tower intended to be 548ft. high, surmounted by a bronze statue of William Penn. This has been constructed up to 335ft. in white marble, the final 213ft. being made of cast iron, which is to be subjected to a dead plating in aluminium, to harmonise in colour with the masonry. The plating work has been undertaken by the Tacony Iron and Plating Company, of Tacony, Philadelphia, who have laid down the necessary plant and completed the covering of two of the large columns, 20ft. high, weighing six tons each, which are designed to carry the crowning dome of the tower.

The object intended to be covered with aluminium is carried by an overhead traveller into a shop containing six tanks arranged in two parallel series. These are made of wood, and are 28ft. long, 5ft. wide and 8ft. deep, or sufficiently large to take the largest casting in the structure. Each tank rests in a separate cement pit, the top of which is level with the floor. The pit is then filled with water, in order that both sides of the wood-work may be subjected to an equal fluid pressure. The object under treatment is deposited in the first tank, which contains caustic soda lye, and remains 24 hours, in order to remove grease. It is then transferred to the second tank, containing weak acid, where it is pickled to remove scale and oxide, remaining for another 24 hours. When taken out the casting is thoroughly cleansed by hand with steel scratch-brushes, after which it receives a preliminary covering with copper by 24 hours' immersion in tank No. 3, a second and heavier coating of the same metal being given by 72 hours in tank No. 4. It is now ready to be covered with aluminium, which is done electrolytically in tank No. 5. The current is supplied by four large dynamos made by the Zucker and Levitt Company, of New York. The aluminium anodes used are each 4ft. long, 12in. wide, and $\frac{3}{16}$in. thick, and weigh 35lb., 60 of them being suspended round the interior of the tank. The thickness of the deposit is $\frac{1}{100}$in., corresponding to 50lb. for each of the 20ft. columns. The operation requires 72 hours, the casting being turned every two hours night and day. The last tank contains hot water, in which the casting remains long enough to be thoroughly washed, and is then finished. The operation lasts nine days; but as the process is continuous, the finished objects succeed at intervals of three days. The total surface of the castings intended to be covered is about 100,000sq. ft. The statue forming the finial of the tower is 38ft. high, contains 50,000lb. of bronze, and is built up in sections 72 in number, averaging about $\frac{1}{4}$in. thick, which are flanged and bolted together.

* Inst. C.E.: Foreign Abstracts.

'TIS a poorly circulated publication that brings no advertiser an inquiry.

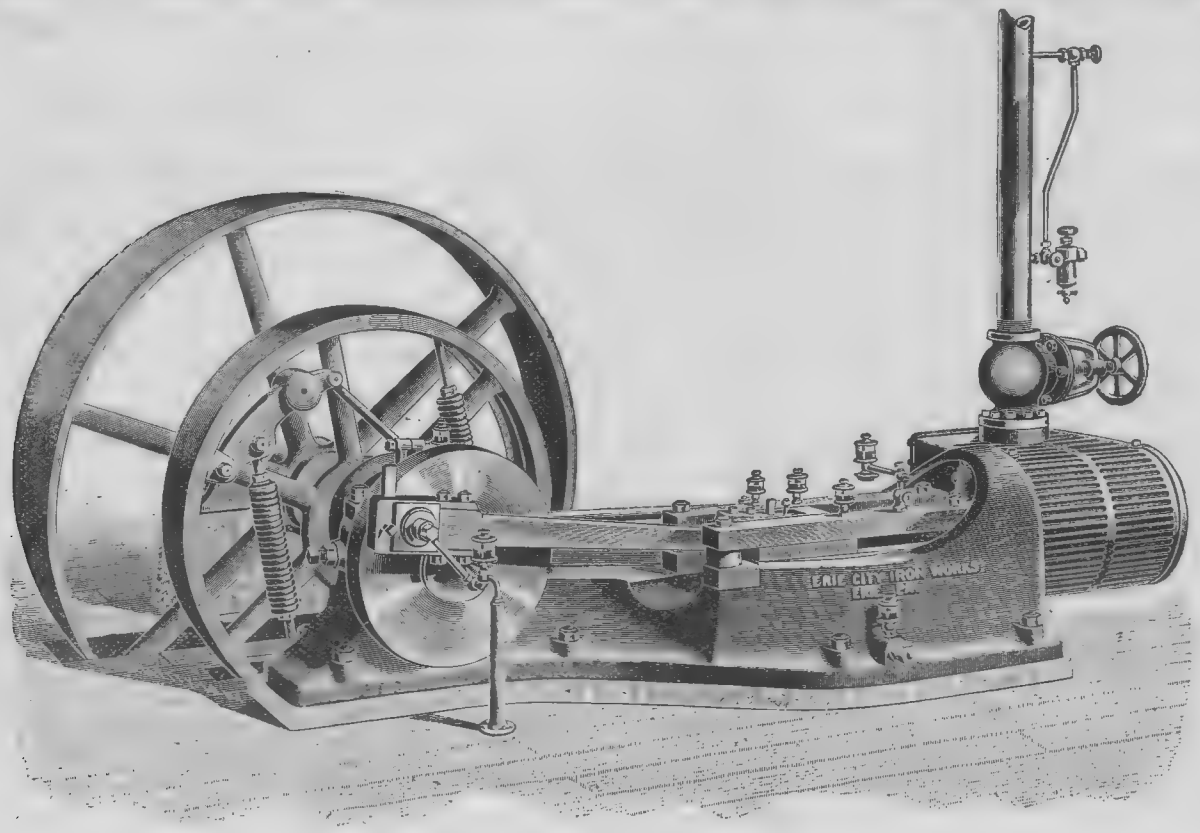
A HALF-INCH advertisement regularly inserted is better than none.

THE true test of value to advertisers is the number of copies paid for, because if a journal is worth paying for, it is read.

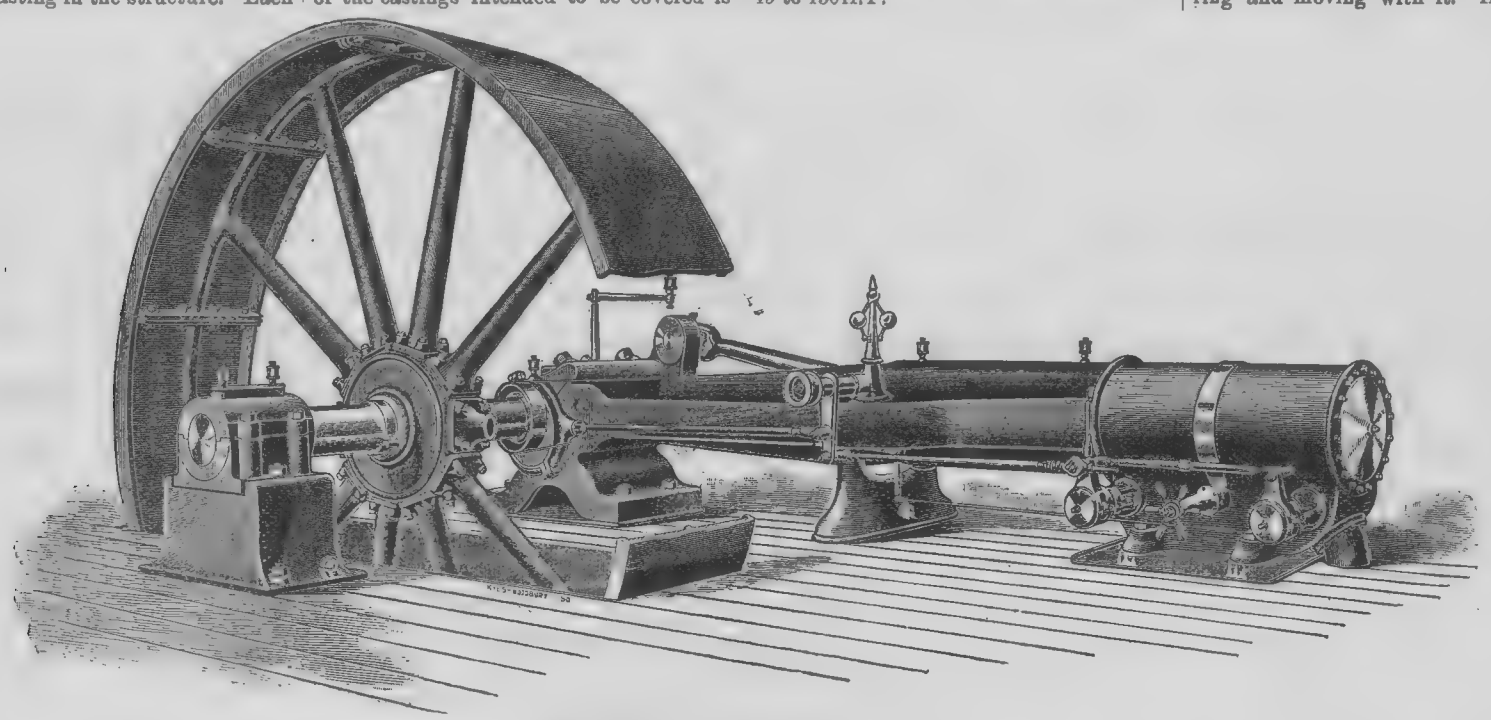
THE MECHANICAL WORLD has a greater sale than all other recognised Engineering Journals combined.

Some Recent American Engines.

IN the accompanying illustrations we give two recent examples of American practice in horizontal-engine construction, which will doubtless prove of interest to many of our readers. In Fig. 1 is shown a new Tangye engine lately introduced by the Erie City Ironworks Company, Erie, Pa. The bedplate is of the well-known Tangye type, which admits of the best distribution of metal so as to combine the greatest strength with symmetrical appearance. The cylinders are fitted with balanced slide valves and an improved automatic shaft governor. A high initial pressure in the cylinder is provided for by large ports which are equal in length to the diameter of the cylinder, and are so located as to ensure perfect drainage. The main journal boxes are fitted with patent quarter boxes, so that all wear in this portion of the engine is easily adjusted and the alignment maintained perfect. These engines are made in six sizes, varying from 45 to 130H.P.



SOME RECENT AMERICAN ENGINES.—FIG. 1.



SOME RECENT AMERICAN ENGINES.—FIG. 2.

The other engine shown in Fig. 2 is an improved Wheelock engine fitted with Hill's valve gear, illustrations of which are given in Figs. 3 and 4. So far as the general design of the engine is concerned, no very striking departure has been made from the ordinary Wheelock engine as made for a number of years by the Wheelock Engine Company, of Worcester, Mass. The Hill valve gear has been developed during the last two or three years, and is now fitted on to most of the engines.

The view of the valve gear shows it complete for one end of the cylinder, having steam and exhaust valves and seats, together with all operating parts. The valves are of an elongated grid-iron pattern, mounted in a taper plug, on the outer end of which is the driving gear, each plug carrying its entire valve gear (except the driving rod and governor connection), and also forming the single port, which serves as inlet and outlet for steam. The plugs are fitted into corresponding taper holes bored in the cylinder, and are held in place by friction, the outer end of each plug being covered by an ornamental cap. The position of the plug with reference to the cylinder, and the arrangement of valves and ports in the plug, are shown in the cross section.

The valves have a reciprocating longitudinal movement, and are driven by cam slots in an oscillating ring operated by the eccentric, as shown in the illustrations.

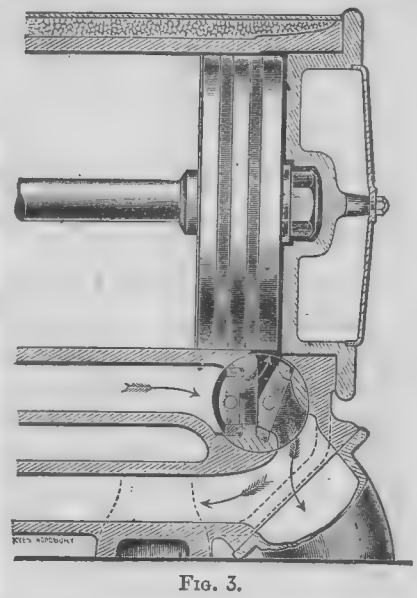
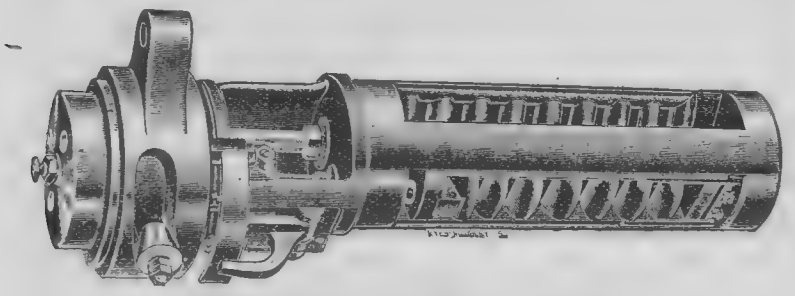


FIG. 3.

The outer ends of the valve stems connect with slide blocks, upon which are studs carrying conical rollers, which match with and work in the cam slots. It is clear that the oscillations of the cam will impart motion to the valves in the desired direction. The exhaust valve receives a direct and positive motion, but the cut-off valve stem is not connected to the cut-off slide block direct. The latter is driven positively by the cam, and is connected with the cut-off valve stem through a latch similar in function to those in general use on valve gears, but differing widely in the form of application. The latch is disengaged by a trip piece pivoted to the cam ring and moving with it. A regulating ring, over which the trip piece is drawn by the cam ring, is provided with a cam-lifter at a certain point, which causes the trip piece to rise slightly when it reaches that point, thereby disengaging the latch through contact with a horn on it, which is plainly shown in the general view of the gear. The regulating ring turns freely, and is connected to the governor, thus determining the point of cut-off. It is provided with a safety cam-lifter that holds up the latch and prevents the inlet valve from opening in case the governor slows down from any cause. The cut-off

valve closes by the action of the steam pressure on the valve stem area.

It is claimed that the advantages of the Wheelock valve system are fully retained in the Hill system, while it is an advance on the Wheelock crank and link connection with a rocking stem. One feature of the Wheelock motion is that it begins very slow and has a rapid finish; thus by using all the available time in the stroke, gaining power to move the valve off its lap, and when fairly off, to give a quick port opening. This same motion, in greater degree, is obtained from the cams by giving the slots a suitable shape, as shown in the engraving, which permits of a very abrupt movement, together with smoothness of operation. The large wearing surfaces specially adapt this valve gear to high pressures and heavy-duty service. The valves are composed of short deep members, particularly adapted to resist deflection, thereby securing even wear and preventing leakage, especially if subjected to heavy pressure. The ample proportions of the valves are suggested by the illustrations, though, by way of comparision, it may be stated that the latch and steel catch plates, which in the Wheelock gear have a width of 1in., are 2½in. wide in the Hill gear, all other dimensions being increased in about the same proportion.



Some Recent American Engines.—Fig. 4.

Steam being taken from below the cylinder, any water of condensation in the steam pipe is prevented by gravity from going into the cylinder, and flows naturally downhill, through the inlet and outlet valves, as will be apparent by a glance at the sectional view. The inlet valve being free to lift from its seat, exposing the whole port area, will act as a most efficient relief valve in case any extraordinary rush of water should be swept by the steam current into the cylinder. Another point of advantage claimed by the builders for the arrangement of steam chest and valves shown, is that there is a certain amount of mechanical separation of water from the steam entering the cylinder. Another advantage is the small clearance, which is evident from an inspection of the section. This is secured by having only one port opening into the cylinder at each end, with an area just sufficient for the exhaust and no more; by the space between the valves and cylinder being V-shaped and as small as possible; and by using a piston rod that cannot be much changed in length by keying up, so that the piston runs much nearer the head than is usually the case.

We are indebted to "Power" for some of the foregoing particulars of the Wheelock engine.

Stephenson's old engine, the "Rocket," in the South Kensington Museum, has just been placed upon old rails of 1829, which Mr. Clement E. Stretton has presented to the institution.

Notes on the Design of High-pressure Steam Generators.*

By B. H. Thwaite.

In a lecture delivered before the Textile Society of the Yorkshire College, on the subject of "Steam Generation," the author explained that although the modern high-class steam engine, according to Carnot's law, and taking the low ranges of temperature into account, gives a fairly satisfactory thermo-dynamic efficiency, nevertheless the improvement in the generally adopted form of steam generator had not followed correspondingly with that in the steam engine, and further, that the design of steam generators of the most typical form for land and marine uses was not creditable to the engineering profession.

The present designers perpetuate the neglect in design of the consideration of the following thermo-chemical and thermo-physical effects:—(1.) The molecular dilatancy of metals due to the increase of temperature. (2.) The varying dilatancy due to variations of temperature. (3.) The zones of temperature of varying intensity corresponding with the varying characters of combustion, in different parts of the steam generator. (4.) The varying resistances to the transmission of heat of metals of varying molecular density, such as steel (high and low carbon) and wrought and cast iron. (5.) The varying degrees of resistance to the transmission of heat due to the varying metallic thicknesses. (6.) The variable coefficients of expansion and contraction of wrought iron, cast iron, and steel. (7.) The exact phenomenon that characterises the production of steam evolved from water enclosed in metallic envelopes. Each bubble of nascent with the molecular expansion of the water. Immediately the deposit is formed in the absence of erosive circulatory currents, the heat bakes the deposit firmly on to the surface of the metal. (8.) The deposition of foreign matter on the heating surface sensibly interferes with the transmission of the heat through the plates. The degree of such deposition is, of course, purely a function of the degree of impurity of the feed water. (9.) The erratic and chaotic nature of the circulatory currents of water in the steam boilers of the usual types, the power of controlling the direction being generally ignored. (10.) The vibratory molecular or pulsatory effect set up by rapid alternative periods of cooling and heating, such as results from the opening and closing of the furnace doors. (11.) The influence of irregular combustion of fuel on the grate and the production of variations of the heat, and the consequent setting up of pulsations of expansion and contraction of the furnace structure. (12.) The influence of a deposit of carbon in interfering with the free transmission of heat through the metallic envelope. (13.) The corrosive influences of moist brick foundations. The capillary attraction of bricks in absorbing water from the foundation and transmitting it to the boiler contact part of steam produced from water containing, either in solution or in suspension, argillaceous, calcareous, saline, or organic matter, leaves a lime, siliceous, or organic deposit on the metallic surfaces, which deposition may be said to be setting, which is, in many instances, inaccessible for examination.

The series of neglected influences in their *ensemble* present a formidable indictment of neglect, but each one can be proved by such arguments as the following:—

The form of the Lancashire, Cornish, and marine steam generator involves, both in the production and application of heat, an absolutely partial and irregular distribution of the heat produced.

Consider the usual furnace: Here we see the roaring blaze associated with actual combustion deliberately applied to the upper half of the furnace flue, to the lower or invert half of which there is practically no application of heat whatsoever. The plates of this flue are held comparatively rigid by the endplates, while at their outer peripheries are held together by the

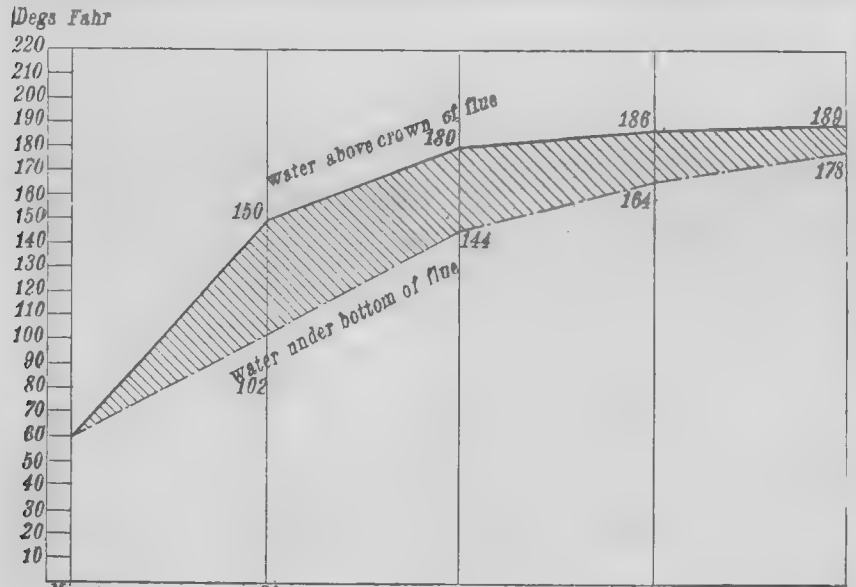


Fig. 1.—Diagram showing variation of temperature to which a horizontal furnace flue is subjected. Gas burned at the rate of 5½ cubic feet per hour.

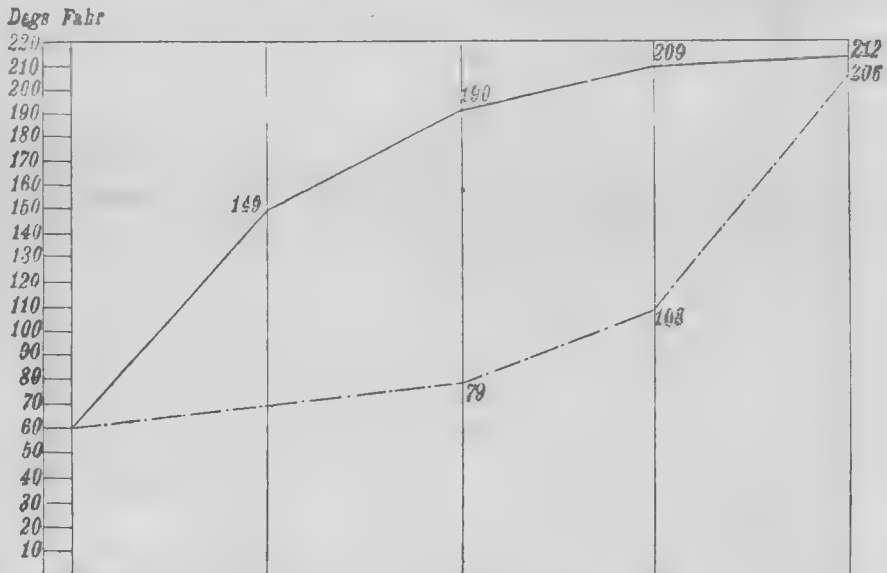


Fig. 1a.—Diagram showing temperature variation to which a horizontal furnace flue is subjected. Gas burned at the rate of 6¾ cubic feet per hour, or an increase of heat application equal to 22·2 per cent. on the other experiment.

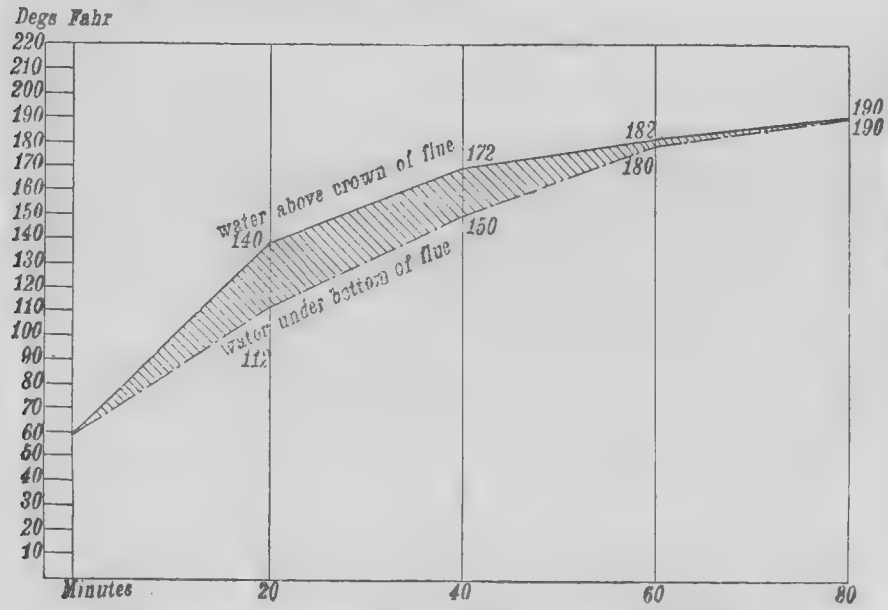


Fig. 2.—With Thwaite's Saddle Circulator. Gas burned at the rate of 5½ cubic feet per hour.

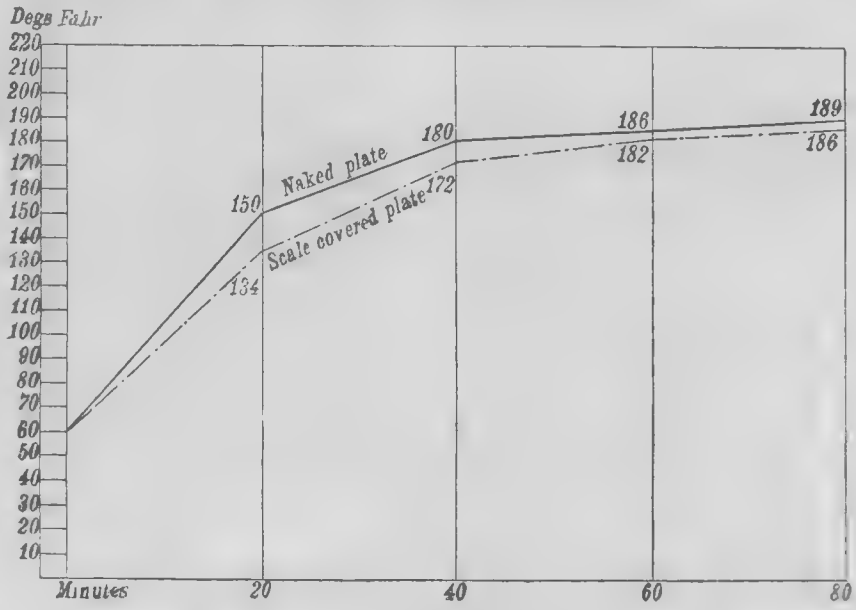


Fig. 3.—Diagram showing reduced evaporation efficiency due to scale. Gas burned at the rate of 5½ cubic feet per hour.

* Paper read before the British Association (Mechanical Section).

outer shell, which latter is exposed on the other half to merely the temperature of the atmosphere and of the steam, whereas the lower half of the outer shell is exposed to the temperature due to the sensible heat of the products of combustion, so that the invert of the internal flue and invert of shell have absolutely opposite applications of heat, or a negative and plus effect. The upper halves or convex parts of flue and shell have inverse effects, with the result that the strains on the endplates are exceedingly severe. The molecular dilatancy of the heated portions of the plate have a tendency to force out the endplate at the line of contact, whilst the colder portions hold the plates *in statu quo*. Because combustion is merely a series of impulses, each impulse of action sets up a vibratory or pulsatory effect, which soon loosens the rivets or produces fissures in the end flanges; but whether the rapid and incessant vibration sets up electrolytic action on the water or not, it is unnecessary to discuss.

To actually and precisely determine the relative differences of temperature of the upper and lower half of the water in the flue, and to ascertain whether there was any transfer of heat from the fire to the lower half or invert of the flue, the author had tests very carefully made on a scale model steam generator, in such a way that the temperature of the water over and above the flue could be absolutely taken.

A model steam boiler of the Cornish type was prepared, gas-fired in such a way as to imitate as near as possible the actual conditions of an ordinary grate fire. The air for supporting the combustion of the gas flowed through the passages of a grate. Ordinary Manchester gas was burned, supplied at constant pressure, the regulation being exactly controlled by reference to a special test meter; 5¼ cubic feet of gas were burnt per hour, the weight of purified water employed in the test being in each instance 10lb. The temperature of the water immediately before the commencement of each of the tests was brought to 62° F. Thermometers were located in the water space both over and under the flue.

The experiments were carried out in the laboratory of the Royal Institution, Manchester, under the supervision of Mr. William Thomson, F.R.S.

The results are shown in the diagrams, the curve of which shows clearly the rates of difference of the two temperatures of the water below and above the furnace flue, and the corresponding stress that must be set up in the flueplates and endplates which may, with inferior steel plates, be sufficient to deflect the plate beyond the elastic limit, or produce a permanent set, eventuating in a fracture.

The temperature variation — between the water over the top and under the bottom of flue—is represented in percentage of total increase of heat as follows (see Figs. 1 and 1A):—

	Percentage of Difference of Temperature.
At the end of first period of 20 minutes	32
At the end of second period of 20 minutes	24
At the end of third period of 20 minutes	11·8
At the end of fourth period of 20 minutes	0·58

The test was repeated under precisely similar conditions, but a Thwaite saddle circulator was applied, the difference in temperature between the water over and under the flue and the associated strains set up were reduced, as seen (Fig. 2):—

	Percentage of Difference of Temperature.		Percentage of Reduction by use of Saddles.
At the end of first period of 20 minutes	20	....	62·5
At the end of second period of 20 minutes	12·8	....	36
At the end of third period of 20 minutes	0·11	....	90
At the end of fourth period of 20 minutes	0·00	....	100

Hence it is obvious that by means of a simple mechanical arrangement beneficent circulatory currents of a specific direction can be established, by which a greater uniformity of temperature can be secured; nevertheless, there is always a difference of temperature between the water over the flue and that underneath, a defect that can only be overcome by the abandonment of the design altogether.

For large steam generators it is, of course, evident that a method of feeding the boiler with hot water is the best remedy for the initial and serious variations of temperature.

Besides the varying circumferential temperature described, there is the longitudinal variation, which is accentuated by that innovation of questionable value—the introduction of cross tubes. The latter, located at varying distances along the flue, are surrounded with varying zones of temperature intensity, producing an unequal degree of dilatancy, which, however, in this instance is not as important as the one just described.

In marine boilers, the varying zones of temperature are more conspicuous, and here it may be stated that the ordinary type of return-tube marine boiler is as much a monument of demerit as the ordinary high-class triple-expansion engine is of merit. The latter is a credit to engineers, which is, however, somewhat tarnished by the defects in the design of the marine boiler.

The evils of unequal dilatancy are increased, but the most objectionable feature is the nest of tubes and stay-tubes above the furnace flues. Here we have the furnace flue attached to a flueplate which should have a certain elasticity, but which is held with deliberately intended rigidity by a nest of tubes which are maintained at a very much lower temperature than the furnace flues. We can approximate the temperatures of the different portions of a marine boiler, commencing at the furnace end, and immediately over the grate. We may with sufficient accuracy assume the temperature to range from 2300° to 2000° F., and from this latter degree the curve of temperature rapidly falls to a temperature of 1200° at the end of the furnace flue, and is further reduced in passing through the small generator tubes to 900° and less, so that the average temperature of the upper half of flue of furnace over the grate $= \frac{2300° + 2000°}{2} = 2150°$, and the average temperature of flue beyond the grate is $\frac{2150° + 1200°}{2} = 1675°$, and the average temperature of the nest of small tubes is $\frac{1675° + 900°}{2} = 1287°$. The latter is therefore 25 per cent. less than the average temperature of the furnace flue beyond the grate, and about half the temperature of the part of flue enclosing the firegrate.

The relative dilatancy of the tubes and the flue will be in an equivalent measure. It is therefore extraordinary that the flue connections and tube junctions with the endplate are the *bête noir* of the supervising engineer, and a source of much vexation and anxiety.

No one who has studied the laws of heat will doubt the statement that, similar to the influence on the flow of the electric energy, the molecular density of the metallic conductor is a factor upon which the degree of resistance to the transmission of heat depends, so that it is desirable that a steam boiler should be constituted of metals of nearly similar density—not partly of iron and partly of steel, but wholly of one or the other, otherwise there is not only an unequal degree of heat transmission and unequal temperature, but there is an initial variation of molecular dilation, due to the varying density of the constituent elements.

The evolution of steam from the feed water of a calcareous or magnesian character is associated with the *pari passu* deposition of the latter, and if there is not an erosive circulatory action of the water sufficiently adequate to clear away the nascent deposit it will accumulate as a hard and adherent film of scale on the surface of the metal.

To ascertain the precise influence of scale as a deterrent to the transmission of heat, the author had careful tests made.

The experimental apparatus was the same model steam generator of the Cornish type, and the other arrangements were identical with those already described.

A synthetic production of calcareous scale formation was applied about ⅛in. thick. The whole circumferential surface of the flue was covered. The temperature observations were taken at periods of 20 minutes, as before. The percentages show the relative ratio of reduced transmissions of heat compared with former tests with clean plate surfaces (Fig. 3):—

	Percentage of Reduction of Water under Flue.		Percentage of Reduction of Water over Flue.
At the end of first period of 20 minutes	16·6	.....	8
At the end of second period of 20 minutes	4·4	.....	3
At the end of third period of 20 minutes	2·1	.....	3·6
At the end of fourth period of 20 minutes	1·6	.....	Not defined.

The ratio of increased loss by covering the whole of the flue with scale, compared with the application of the scale to merely the upper half of the flue, and measured by the increased sensible temperature of the gases leaving the flue, was found to be 21·7 per cent., so that the loss in steam furnace efficiency by the thinnest scale is a serious and substantial one, increasing the strains on the boiler plates and reducing the absorption of heat assets supplied.

(*To be continued.*)

An Appliance for Autographically Recording the Temperature of Furnaces.*

In these days of accurate observation, when the speed of projectiles is both autographically recorded and their actual paths photographed, it is remarkable that the measurement of high temperatures has not kept pace with the recent industrial appliances of physical methods. In the case of certain chemical and metallurgical processes a variation of only a few degrees may, at certain stages of the operations, be fatal to their success; and even when heat is generated in the vast interior of a modern blasting furnace, the accurate regulation of the temperature is of great moment. The importance, for instance, of ascertaining by actual measurement the relation between the number of calories brought in by the blast and the total heat engendered by the combustion of fuel in the furnace, will be evident when the appropriation of the heat of an 80ft. blast furnace during the production of 20cwt. of pig iron from Cleveland ore is considered. Of the total 93,000 calories which are employed, nearly 12,000 calories, or more than double the number brought in by the hot blast, are allotted to the reduction of the calcium, silicon, phosphorus, sulphur, and elements other than iron present in the charge. The influence of the temperature of the blast is moreover, as is well known, of great importance in determining the composition, and consequently the reductive energy of the gases formed at the level of the tuyeres. Hence the need for accurately adjusting the temperature of the blast, if the furnace is to yield its maximum out-turn, or if the production of a given quality of iron is to be maintained. Analysis shows the degree of purity of the mass, for the application of chemistry to the metallurgy of iron has enabled amounts of foreign elements in iron to be estimated in the routine of daily work, even though not more than one-hundredth part be present. May it not be hoped that, by giving increased attention to physical methods, it will be possible to regulate the thermal conditions which determine the passage of elements into the iron?

The adoption of thermo junctions for the measurement of high temperatures has been for some years advocated by the author, and will probably become widespread, Sir Lowthian Bell leading the way in this country by the introduction of platinum platinum-rhodium thermo junctions into the hot blast mains at the Clarence Works, the thermo junctions being connected with a central laboratory, where the indications they afford are translated into degrees by the aid of a suitable galvanometer. Various other methods have, as is well known, been employed for measuring the temperature of the blast; but, as yet, a systematic method of obtaining autographic records of the temperatures has been wanting, and it would appear that the time has fully come for taking a step in advance. It was with much pleasure, therefore, that the author received a request from Mr. E. P. Martin, of Dowlais, that these works might be furnished with an appliance which should faithfully record the temperature of the hot-blast stoves. Mr. Riley had already introduced at the new works at Cardiff a method for recording the periods at which the reversal of the valves was effected, and he was thoroughly able to appreciate the need for obtaining an equally trustworthy record as to the temperature attained. The present paper is the result of an effort to provide such an appliance by simplifying a piece of apparatus, already described by the author to the members of this institute, so as to render it serviceable for use in works.

The original apparatus consisted of a camera containing a reflecting galvanometer of the Depretz and D'Arsonval type of about 200 ohms resistance. The thermo junction—which is, of course, external to the camera—is connected with this galvanometer, and the amplitude of the deflection of a spot of light from the mirror affords the basis in calculating the temperature to which the thermo junction has been raised. An autographic record of the temperature may then be readily obtained if the spot of light from the mirror falls into a sensitised photographic plate actuated by an astronomical clock or by other suitable mechanism. Such an appliance, though it has proved to be well adapted for conducting investigations, is not sufficiently simple for industrial purposes, and in order to render it generally useful it appeared that the following points had to be attended to:—

1. It was necessary to simplify the portion of the apparatus which receives and records the movement of the spot of light; and

2. To avoid the necessity for shifting a single thermo junction from furnace to furnace by placing separate thermo junctions in each furnace, provision being made for placing each centre of heat in turn, in connection with a single galvanometer and recording instrument.

The first object has been attained by replacing the moving plate of the original apparatus by a brass cylinder 6in. in diameter, moved, at the rate of a single revolution in twelve hours, by clockwork contained within it. This cylinder has sensitised paper fixed round it, and the portion of the camera which contains it can be detached from the rest of the appliance and removed to the dark room for the development of the record imparted to the paper.

In the apparatus now submitted to the members of the institute provision is made for placing any one of six centres of heat, such as hot-blast stoves or furnaces, in connection with the galvanometer, and for obtaining within the period of the revolution of the cylinder a record of the temperature of any one or of all the six sources of heat. The record of a number of furnaces would, however, be intermittent, the duration of the test in any particular case being subject to the will of the operator, who by merely turning a handle determines which particular furnace shall be placed in connection with the galvanometer, and the length of time which shall be devoted to its test. This shifting of the electrical contact from furnace to furnace could readily be effected by clockwork, and the tests would then be entirely independent of manual adjustment.

* Paper by Professor Roberts-Austen, F.R.S., read before the Iron and Steel Institute.

On Shipbuilding in Portsmouth Dockyard.

(*Continued from page* 123.)

"*Royal Sovereign.*" — The "Royal Sovereign" of 1892 is a very different ship in all respects from her predecessor of the same name completed in 1864. So much has of late been said and written respecting the vessel, that further description of the leading features in her design is here unnecessary.† It will not be out of place, however, to give a few particulars of the remarkable speed with which the work of building was carried on. Instructions to prepare to build were received on 1st May, 1889. Full drawings and specifications were furnished on 3rd August. The keel was laid on 30th September, 1889, by which time a large amount of preparatory work on framing, etc., had been done. On 26th February, 1891, the ship was floated out of the dock where she had been built, fully armoured, and weighing at the time considerably over 7000 tons. The engines and boilers were ready, and were at once put on board. By 19th April, 1892, she was practically complete, and passed successively through her steam, gunnery, torpedo, and electrical trials, from that date to 22nd April. A month later she was passed into the fleet reserve as ready for commission; on 31st May she was commissioned, and on 8th June she left for Portland, carrying the flag of Vice-Admiral Fairfax, in command of the Channel Squadron. From the date of laying the keel to the date of commissioning only two years and eight months elapsed. No similarly rapid construction of a modern first-class battleship has been achieved, and the Admiralty officially expressed their satisfaction with the conduct of all concerned.

The magnitude of the work will be better appreciated from the following figures:—In the first three months after laying the keel, over 1000 tons of structural steel, etc., were worked into the ship. At the end of six months this had been increased to 2100 tons. Twelve months from the start about 3800 tons had been worked into the hull, exclusive of armour, which alone represented about 1400 tons; so that, inclusive of armour, a weekly addition of 100 tons weight had been averaged. Six months later, or a month after the ship was floated, the hull weights exceeded 4600 tons, and the armour approached 2900 tons. Two years from laying the keel these weights had become 5300 tons in the hull, and 2950 tons in the armour; and when the ship was finished the total weight worked in

† Reference may be made to papers by the author "On the Designs for the New Battleships," published in the Transactions of the Institution of Naval Architects, 1889, vol. xxx., page 150; and "On the New Programme for Shipbuilding," published in the Proceedings of the Institution of Civil Engineers, 1889, vol. xcviii., page 375.

had risen to 9800 tons, inclusive of about 3000 tons of armour.

This rapid progress demanded the most thorough organisation and strenuous effort on the part of the officers at Portsmouth. It was rendered possible by the steps taken at the Admiralty in placing orders for materials, especially armour, propelling and other machinery, guns and gun mountings, and hydraulic apparatus, so that there should be no check to progress. Private firms entrusted with this work also deserve much credit for the manner in which, under considerable difficulties, they executed their contracts. The armour plates were ordered before any portion of the ship was to be seen. Within 4½ months from laying the keel, and before the ship was ready to receive armour, the first plate was delivered. When she was floated out of dock nearly all the armour was in place. Messrs. Cammell spared no exertion in effecting this delivery. The machinery contractors, Messrs. Humphrys and Tennant, began delivery of the engines and boilers in November, 1890, anticipating considerably their contract dates, so that their work was waiting for the ship when she was floated out. Sir W. G. Armstrong, Mitchell and Co., the designers and makers of the hydraulic gun-mountings, etc., for the 67-ton guns, and of the 6in. quick-firing guns and their mountings, gave equally early delivery, and by so doing contributed greatly to rapid completion. In short, this unprecedented feat in warship building was the result of careful forethought and organisation, as well as of unremitting and harmonious effort on the part of all concerned.

The "Royal Sovereign" has been built with no important variation from the original design. The intentions of the design have been fulfilled or surpassed in every particular. Rapid construction, moreover, has been conducive to economy, and the vessel has been completed for about £35,000 within the estimate for dockyard work. The original estimate of cost, excluding guns and ammunition, as well as incidental charges, was £780,000, which was subsequently raised to £790,000; and the actual cost will be under £760,000. Guns, ammunition, and reserves, and the consumable stores carried, will bring the total value of the ship as she goes to sea up to a million sterling.

Ships now in Progress.—The vessels now building or completing at Portsmouth include specimens of four types introduced into the navy under the Naval Defence Act of 1889. Three of these are exemplified by vessels building in the yard; the fourth is represented by the second-class cruiser "Intrepid," built on the Clyde and now completing here for service.

"*Centurion.*"—The most important ship is the "Centurion" battleship. She was laid down at the end of March, 1891, and is now well advanced towards the condition for floating out, with hull-armour practically complete. Her principal armament consists of four 10in. 29-ton guns, mounted in pairs in two armoured barbettes, with large arcs of horizontal training. All these guns can be fought on either broadside. Manual power can be employed for all the operations of loading or working these guns. Steam power is also provided for training the guns and hoisting ammunition. The mountings are being made by Sir Joseph Whitworth and Co. Between the barbettes are mounted ten 4·7in. quick-firing guns; and seventeen smaller guns, six-pounders and three-pounders, are also carried. There are seven stations for ejecting torpedoes. Two of these are under water, four on the broadside behind light armour, and one at the stern.

A belt of armour, having a maximum thickness of 12in., protects the water-line region for about 200ft. of the length. This belt armour is associated with a protective deck 2in. to 2½in. in thickness, and is completed at the extremities by armoured bulkheads crossing the ship. A strong protective under-water deck runs from these bulkheads to the bow and stern respectively. Above the belt armour the broadside is protected by light armour, equivalent to a total thickness of 4in. of steel, up to the height of the main deck, which is about 9½ft. above water. Protection is also given to the quick-firing guns and their crews by revolving shields or fixed casemates.

The hull is of steel, built on the system usually followed in the navy, and is minutely subdivided. Steel armour made by Messrs. Vickers is fitted on hull and barbettes. Wood and copper sheathing are fitted on the bottom, to prevent fouling and consequent loss of speed after long periods afloat. The ship is thus specially adapted for service on foreign stations. She is of light draught as compared with most battleships of her size, and will be able to pass through the Suez Canal with a large quantity of coal on board, being in all other respects fully laden.

Relatively high speed is aimed at in the design; and larger and heavier boilers than have hitherto been fitted in battleships have been provided, so as to secure the maintenance of speed on long-distance steaming. The Greenock Foundry Company are the contractors for the propelling machinery.

The estimated cost of the "Centurion," exclusive of armament and incidental charges, is about £550,000. She will probably be completed in the autumn of next year.

(*To be continued.*)

Metal Trade Memoranda.

Platinum, in good quality and of considerable quantity, has been found on the Pacific coast.

A new steel plant is about to be put down by the Round Oak Iron and Steel Works Company, near Dudley.

The Gellivara Company, Sweden, have to the middle of September shipped over 100,000 tons of iron ore abroad.

The Normanby Iron Company will have another furnace working on hematite in a few days, and its third furnace will be in blast early in October.

Several additional tinplate mills in the Aberdare and Swansea districts ceased work on the 20th inst., owing to the operations of the M'Kinley Tariff Act.

Negotiations have been opened by a firm buying iron largely, to purchase the Hope Ironworks, Tipton, which have stood idle since the suspension of the last owners.

The Dowlais Iron Company are erecting two more blast furnaces on the East Moors at Cardiff. When the additional furnaces are in working order, the Company's output will be about 4000 tons of pig iron per week.

Mr. Capelle, the French chemist, recommends the following solutions for plating with iron and nickel:—Solution first, for iron: Take equal parts of pure sulphate of iron and of the sulphate of iron and ammonia, to which is added 1 in 1000 of sulphate of magnesia. The solution should have a strength of 18° to 20° B. Solution second, for nickel: To a solution of sulphate of nickel and ammonia, 2 per cent. of sulphate of magnesia and 2 per cent of boric acid is added, and the solution is then neutralised with carbonate of magnesia. The bath should have a strength of 8° to 10° B.

The Metal Market.

PRICES CURRENT.

LONDON, September 26.

COPPER began with bids of £43 10s. and £43 12s. 6d. for immediate delivery, after which a smart trade was done at £43 12s. 6d. to £43 15s. for cash, and £44 2s. 6d. to £44 5s. for three months, the advance being steadily made under influential support and a better general inquiry. Owing to a falling off in the demand, however, the tone after the official close was barely steady, values being 3s. 9d. to 5s. better on the day. Sales, 700 tons. Settlement price, £43 15s. English tough, £47 5s. Best selected, £48 to £48 5s. Strong sheets, £55.

TIN was bid for at £91 12s. 6d. cash at the opening, and the small demand was afterwards freely met. Later in the day, under sales to realise, 2s. 6d. less was taken for cash, the large quantity offered, however, being readily taken, and the close is steady after business in two months' options, at £91 15s., final rates being 2s. 6d. to 5s. lower than Friday. Sales, 230 tons. Settlement price, £91 10s. English ingots, £94 10s.

PIG IRON has been inactive. For three months 42s. was offered, but sellers wanted 2d. more, and no business was done, Scotch closing ½d. better for cash, while Middlesbrough was 3d. higher, and hematite unchanged. Settlement prices.—Scotch, 41s. 7d.; Middlesbrough, 39s. 9d.; hematite, 49s.

TINPLATES remain dull at 12s. 9d. for I.C. cokes f.o.b. London, while Liverpool f.o.b. is 12s. 3d., and Swansea 11s. 9d.

LEAD remains firm and unchanged. Spanish on spot, £10 7s. 6d.; forward, £10 6s. 3d., sellers. English, £10 7s. 6d.

SPELTER is steady at £18 10s., sellers, October shipment. Silesian special brands, £18 15s.

ZINC SHEETS.—Silesian quiet; ordinary brands, £21 5s. ex. ship; Belgian flat and 5s. lower; V.M. brands, £21 15s. ex. ship, and £21 12s. 6d. f.o.b. Antwerp.

ANTIMONY is unchanged at £43 10s. for usual marks.

QUICKSILVER remains quiet, and is 6d. easier at £6 5s. from second hands, but importers hold for £6 7s. 6d.

OFFICIAL CLOSING QUOTATIONS.

	£	s.	d.	£	s.	d.
COPPER—						
G. M. B.—Cash	43	15	0—44		2	6
" Three months	44	5	0—44		12	6
English tough	—	—	—			
Best selected	—	—	—			
Strong sheets	—	—	—			
TIN—						
Fine foreign—Cash	91	10	0—92		0	0
" " Three months	91	17	6—92		7	6
Australian—Cash	92	0	0—92		10	0

PIG IRON—	s.	d.
Scotch warrants Cash	41	7
" One month	41	9
Middlesbrough—Cash	39	9
" One month	—	
Hematite—Cash	49	0
" One month	—	

GLASGOW, September 26.—Business was very quiet on the pig-iron market to-day, and only 5000 or 6000 tons of Scotch changed hands, the dealing again being almost wholly of a forfeit character. Prices were very firm, offers of iron being few, and Scotch rose ½d. Cleveland was quoted 8d. up from Friday, those committed on the short side being somewhat anxious to cover. Hematite was neglected. The shipments of Scotch last week reached 8978 tons, being an increase of 556 tons on the corresponding week of last year. The increase to date is now 28,970 tons.

QUOTATIONS.

	Highest. s.	d.	Lowest. s.	d.
Scotch warrants—Cash	41	7½	41	7
" One month	41	9½	41	8
Middlesbrough—Cash	39	9	39	6
" One month	—		—	
Hematite—Cash	49	0	49	0
" One month	—		—	

Trade Marks.

The following is the Official List of Applications published from September 14 to September 21, for the Registration of Trade Marks, so far as relates to the Metal Trades.

CLASSES 5, 6, AND 12.

R. GROVES & SONS
USE
SHEFFIELD

162,575—2778 S. Steel. ROBERT RENTON EADON, trading as MOSES EADON AND SONS, President Works, Sheffield; also as RICHARD GROVES AND SONS, Bee Hive Works, Sheffield; manufacturer.—9th February, 1892. Mark used by applicant and his predecessors in business for 50 years last past.

162,576—2779 S. Machine knives, machine tools, and other similar metal goods in Class 6 and not included in other Classes. ROBERT RENTON EADON, trading as MOSES EADON AND SONS, President Works, Sheffield; also as RICHARD GROVES AND SONS, Bee Hive Works, Sheffield; manufacturer.—9th February, 1892. Mark used by applicant and his predecessors in business for 50 years last past.

162,578—2781 S. Edge tools, including files and saws. ROBERT RENTON EADON, trading as MOSES EADON AND SONS, President Works, Sheffield; also as RICHARD GROVES AND SONS, Bee Hive Works, Sheffield; manufacturer.—9th February, 1892. Mark used by applicant and his predecessors in business for 50 years last past.

CLASS 12.

USE
VICKERS
SHEFFIELD

162,580—2783 S. Files and saws. ROBERT RENTON EADON, trading as MOSES EADON AND SONS, President Works, Sheffield; also as RICHARD GROVES AND SONS, Bee Hive Works, Sheffield; manufacturer.—9th February, 1892. Mark used by applicant and his predecessors in business for 40 years last past.

CLASS 12

B. DAWSON
SHEFFIELD

162,581—2784 S. Saws. ROBERT RENTON EADON, trading as MOSES EADON AND SONS, President Works, Sheffield; also as RICHARD GROVES AND SONS, Bee Hive Works, Sheffield; manufacturer.—9th February, 1892. Mark used by applicant and his predecessors in business for 40 years last past.

CLASS 50.

THE STANDARD ENGINE PACKING
J & S

"*The essential particular of the Trade Mark is the device, and the applicant disclaims any right to the exclusive use of the added matter.*"

164,439. Engine packing (not being metallic packing). JOHN HENRY DEWHURST, trading also as J. DEWHURST AND SON, 70, Attercliffe-road, Sheffield, Yorkshire; consulting engineer and mill furnisher.—28th April, 1892. *By Consent.*

Official Gazette.

Partnerships Dissolved.

R. J. RANSOME and R. C. RAPIER, under the style of Ransomes and Rapier, Ipswich and Victoria-street, Westminster, ironfounders and engineers, by the death of R. J. Ransome.

HENRY WALLWORK, HARRY WALLWORK, R. WALLWORK, and C. H. WALLWORK, under the style of H. Wallwork and Co., Manchester, ironfounders, engineers, and machine makers: as far as regards the two first named.

MOTTERSHALL and CLARKE, Manchester, electrical engineers and agents.

JOHN MALLINSON and JONATHAN MALLINSON, under the style of Mallinson Brothers, Mytholme, near Hipperholme, Halifax, engineers and machine tool makers.

REVIS and MARRIOTT, Nottingham, machinists.

RICKMAN and ATKINS, Walbrook, City, engineers and contractors for water softening and filtration.

THE BANKRUPTCY ACTS, 1883 AND 1890.

Receiving Orders.

WILLIAM LOCKWOOD (trading as W. Lockwood and Co.), Sheffield, engineer.

ARTHUR ABERCROMBIE (trading as Abercrombie and Son), Whitfield-street, Tottenham Court-road, W., and Balham Park-road, S.W., brassfounder and finisher.

JONATHAN BOOTH (trading as Allen, Booth and Son), Rastrick, near Brighouse, ironfounder.

New Companies.

ELECTRICITY SUPPLY COMPANY OF CROYDON LIMITED.—This company was registered on the 16th inst., with a capital of £40,000, in 7900 ordinary shares, and 100 founders shares of £5 each, respectively, to establish and maintain at Croydon a central electricity supply station, and to supply electricity for the purposes of light or power. Registered by Messrs. Harrison and Robinson, 263, Strand, W.C.

OZONE SYNDICATE LIMITED.—This company was registered on the 15th inst., with a capital of £25,000, in £5 shares, to carry on, within the United Kingdom, the business of ozone producers, sugar refiners, engineers and contractors, manufacturers of sugar-refining and other apparatus, and electrical, mechanical, and chemical engineers, and any other business or businesses convenient to be carried on with such business, or any branch thereof; and for the purposes aforesaid to acquire lands, works, property, and premises wherever convenient, patent rights and other property; and to acquire and establish other businesses and property of the nature aforesaid, as may seem expedient; and also to carry on the businesses of builders and contractors, engineers, merchants, importers, etc. Registered by Mr. G. Sydney Morse, 4, Fenchurch-avenue, E.C., solicitor. Registered office, 39, Victoria-street, London, S.W.

THE DISTRICT IRON AND STEEL CO. LIMITED.—This company was registered on the 20th inst., with a capital of £50,000, in £10 shares, to purchase, acquire, and to take over as a going concern the three ironworks, lands, buildings, plant, machinery, and fixtures, known respectively as "The District Ironworks," the "Excelsior Ironworks," and "The Dolphin Ironworks," all of which are situated at Smethwick, in the county of Stafford; and also to purchase, acquire, and take over as a going concern, the goodwill of the businesses of finished iron and sheet-iron and steel manufacturers, carried on upon the said works, or some of them, by Messrs. Thomas Keen and Frederick Lennox Broughton, trading as "The District Iron and Steel Company," and generally to carry on the businesses of general factors and merchants, galvanised iron manufacturers, iron founders, brass founders, iron and steel merchants, etc. Registered by Messrs. Jordan and Sons, 120, Chancery-lane, W.C.

THE ELECTRO ALKALI CO. LIMITED.—This company was registered on the 20th inst., with a capital of £160,000, in £10 shares, to enter into and carry into effect, either with or without modification, an agreement to be made between the Electric Construction Corporation Limited, of the one part, and this company of the other part, providing for the acquisition by the company of the patents or patent rights and licence in the said agent referred to, or to purchase or acquire such patents and rights, or any of them, upon other terms; to purchase or otherwise acquire any other invention in relation to any chemical, electrolytical, or electro-chemical process, or to any apparatus, implements, or machinery, for or in connection with electricity, or any such process or manufacture, or of which the acquisition or use may be deemed in any way desirable for, or likely to benefit the company, and generally to develop, improve, bring into public use, and work any such inventions as aforesaid. Registered by Messrs. Bonner, Wright, Thompson and Co., 165, Fenchurch-street, E.C., solicitors.

THE BULL-DOG FRICTION CLUTCH SYNDICATE LIMITED—This company was registered on the 17th inst., with a capital of £5000, in £5 shares, to acquire, by purchase or otherwise, from Messrs. William Ambler and William James Warren, the whole of the rights, title, benefits, and interest, as far as regards Great Britain, in an invention for an improved friction clutch, for which provisional protection in respect of an application for letters patent (No. 1,208,192) has been granted, and for which complete specifications have been filed and grant of letters patent applied for, and the sole and exclusive benefits thereof, and all rights, powers, emoluments, and advantages whatsoever in relation thereto, and generally to carry on the trade or business connected with the manufacture and production, and dealing with all classes of clutches, tools, mechanical appliances, fittings, machines, and manufactures of a similar or analogous description, etc. Registered by Messrs. Edmonds and Edmonds, 9, Gray's Inn-square, W.C., solicitors.

CHARLES JORDAN AND SONS LIMITED.—This company was registered on the 15th inst., with a capital of £30,000, in 3000 shares of £10 each, to establish and carry on, at Newport (Mon.) and elsewhere, the business of steel, iron, and brass founders, mechanical and manufacturing engineers, ship repairers, and manufacturers of agricultural implements and other machinery, tool makers, metal workers, engine and boiler makers, millwrights, machinists, iron and steel converters, manufacturers of gas, steam, water, hydraulic and sewerage pipe castings, girders, bridge work, coke manufacturers, [illegible] woodworkers, builders, painters, metal [illegible] electrical engineers, water-supply [illegible] gas makers, ship store merchants, [illegible] printers, carriers, merchants: and [illegible] to the above objects, to carry [illegible] agreement made August [illegible] John Evan Jordan of Newport [illegible] and Mr. J. S. [illegible] of the other part [illegible] docks, slipways [illegible] Messrs. [illegible] Newport, Mon.

HAND MILLING TOOL CO. LIMITED.—This company was registered on the 17th inst., with a capital of £7000, in 900 £5 shares, and 2500 £1 shares, to carry into effect an agreement made September 14, between Messrs. J. L. Stewart, J Overend and B. Overend, of the one part, and L. Craven, on behalf of this company, of the other part, generally to carry on business as manufacturers of and dealers in milling tools in particular, to acquire certain letters patent relating to improvements in apparatus for manufacturing files and also hardening and tempering blades for the same. Registered by Messrs. Waterlow and Sons, 85, London Wall, E.C.

THE STEEL SLEEPER SYNDICATE LIMITED.—This syndicate was registered on the 16th inst., with a capital of £20,000, in £1 shares, to work, extend, develop or otherwise deal with patent No. 7857-86, and secure the co-operation of railway and other companies in connection therewith or relating thereto, and to sell the same, arrange or otherwise deal therewith in such a way as the directors may determine, or to let on lease, or royalty, or other method as the directors may determine, and to enter into and carry into effect (with or without modification) an agreement to be made between Messrs. Henry Harwood, James Walker, Francis Ermen, Edward Ferdinand Boehm, and William Walker, of the first part, and the Steel Sleeper Syndicate Limited, of the second part; and also an agreement to be made between the Steel Sleeper Syndicate Limited, of the one part, and Mr. James Herbert Wilkinson, of the other part. Registered, without special articles of association, by Messrs. Bower, Cotton and Bower, 4, Bream's-buildings, Chancery-lane, W.C.

THE PATENT AUTOMATIC COUPLER SYNDICATE LIMITED.—This company was registered on the 16th inst., with a capital of £10,000, in £1 shares, to work, extend, develop, bring out, improve, perfect, and otherwise deal with the patent No 2129, 1887, or act in anywise relating thereto or connected therewith, and to form a company or companies, syndicate or syndicates, to deal therewith on such terms as the directors may determine, and to arrange either by purchase, sale, royalty, commission, or any other method, with railway companies in any way relating thereto or connected therewith, and to enter into and to carry into effect (with or without modification) an agreement to be made between Messrs. Henry Harwood, James Walker, Francis Ermen, Edward Ferdinand Boehm, and William Walker, of the first part, and the Patent Automatic Coupler Syndicate Limited, of the second part; and also an agreement to be made between the Patent Automatic Coupler Syndicate Limited, of the first part, and Mr. James Herbert Wilkinson, of the second part. Registered, without special articles of association, by Messrs. Bower, Cotton and Bower, 4, Bream's-buildings, Chancery-lane, W.C.

Letters to the Editor.

*** *We do not hold ourselves responsible for opinions expressed by correspondents.*

*** *The name and address of the writer (not necessarily for publication) must in all cases accompany letters intended for insertion, or containing queries.*

*** *Letters intended for publication in the current week's issue must reach our Manchester Office not later than by the first post on the Tuesday preceding the date of publication.*

CONSTRUCTION AND EFFICIENCY OF LOCOMOTIVE BOILERS.

To the Editor of THE MECHANICAL WORLD

SIR, — Having perused with interest the valuable and well-illustrated paper on the above, I purpose, with your permission, to add a few words on the points raised in the correspondence columns of your last issue, some of which exhibit the writer in the light of *laudator temporis acti*—a not-altogether undesirable attitude, be it said, when criticising the expensive embodiments of the "unrestrained fads and fancies" of our latter-day locomotive engineers. But reckless expenditure on the one hand is no excuse for bad design on the other. Longitudinal lap joints have been so long and thoroughly discredited as scarcely to be worth further serious consideration in connection with high-pressure work. Concerning the high-topped box, one is tempted to inquire the exact value of an additional steam reserve, equal to, say, one second's supply, the critical point being rather the area of the water plane through which all the steam generated has to rise at a velocity depending only on the rate of evaporation and area of free surface for its exit. A *wider* shell is more desirable than a comparatively insignificant increase in height. With good stays to take the longitudinal strain (which, it should be noticed, is only half as great as the transverse), weldless hoops appear a needlessly heavy encumbrance, and, together with the costly angle ring connection at the smokebox tubeplate, might be omitted with no loss of efficiency. "Rivet" will probably find it easier to recommend the drilling of bolt holes through solid roof bars than to sell such costly constructions in the open market. The heavy compression on the vertical plates of the firebox and corresponding tension in the shell, due to the girder system of supporting the roof, encourage leakage and grooving at the foundation ring, and the usual longitudinal placing of the bars provokes leakage at the tube ends by ovalling the holes with the great superincumbent pressure, and by preventing the slight movement of the plate in obedience to the laws of expansion and contraction. The fact that the firebox plates when at work are always hotter, and hence more expanded, than those of the shell, seems to indicate that the pins of the sling links are normally raised from their bearings; the thick plates of English fireboxes can hardly yield sufficiently to bring them taut without enduring damage.

One of our leading railway companies, which I refrain from naming, is hardly in a position to confirm "Rivet's" statement as to water-space stays. Between the years 1883 6 its stock was increased by several classes of locomotives, having water spaces of 2½in. only, and as a consequence breakages, bulged plates, etc., are by no means rare, and enlarging the diameter of the stays only increased the difficulty. It would be an easy matter to demonstrate mathematically that the stress on the stay induced by deflection is directly proportional to its diameter, hence the fallacy of hollow stays for this purpose, as, in addition to the increased expense, they are more susceptible to fracture than a solid stay of equal net area. Hence, also, the reason why the rapid corrosion of iron stays in copper boxes does not produce the expected failures. Unfortunately this is by no means the sole instance of the modern tendency to increase dimensions in almost every part, carrying with it the acceleration of its own failure. Does not "Rivet" lay too much stress on the great (?) difference in conditions to be met with on different lines? Is there not, rather, a strikingly obvious object lesson in the infinitely varied stock with which our railways are so liberally provided—viz., that the promotion of a single locomotive superintendent is often responsible for far greater anomalies than the original location or special needs of the traffic demand?

Birmingham, Sept. 26. J. D. T.

To the Editor of THE MECHANICAL WORLD.

SIR,—I read with pleasure your reprint of a paper on the construction of the locomotive boiler and its efficiency, and although endorsing most of the opinions expressed by the author, I feel compelled to ask you to allow me a little space for a few remarks.

It is perfectly true that direct staying, as carried out on our railways, is irrational, for the action of the stays is to tend to distort the circular top of the firebox shell, which otherwise is in a natural state of equilibrium. The same remark applies to the standard boiler of the Prussian State Railway, in which the stays are vertical, and the sides prevented from bulging by transverse stays above the crown plate.

The Belpaire firebox is, however, free from these objections. The pressure on, say, each square foot of the crown plate is perfectly balanced by the pressure on an equal surface opposite and parallel to it. There is no getting out of that. The Belpaire firebox is the only rational form of firebox with flat surfaces. If proper provision has been made for the initial expansion of the first two transverse rows of stays, this firebox gives no trouble. It is extensively used on the Continent. Many of our colonial railways and some U.S. railroads have adopted it. I quite agree with "Rivet" with regard to the flanged firehole. Solid rings have so frequently given trouble that many foreign railways have adopted the flanged ring.

I have already advocated in these columns the practice followed by Mr. Stirling and a few other English engineers with regard to the abandonment of through stays. I consider they are a great hindrance to more frequent and proper examinations of the internal parts of barrels. What are required are horizontal gusset stays to stiffen the flat ends, as is done by Continental engineers and builders.

I regret that the author did not say a few words about the use of corrugated furnaces in locomotives, as are now being introduced in Germany, and really constitute a radical departure from the practice hitherto followed. Lentz's stayless boiler is, in my opinion, a step in the right direction.

The average proportions for locomotive boilers may be taken as follow:—

The area of the grate should contain as many square feet as there are inches in the diameter of the piston, minus one. The total heating surface is about 63 to 65 times the area of the grate. The heating surface of the firebox should be $\frac{1}{10}$ of the total heating surface. The area of the least section of the chimney should be about $\frac{1}{14\cdot5}$ of the grate. I have obtained the above averages by comparing the proportions of many locomotives built during the last twelve years.

In engines with single driving wheels, the heating surface of the firebox is more often $\frac{1}{9}$ of the total, and the area of the grate is also made larger. For Belpaire fireboxes, the grate area is usually $\frac{1}{30}$, or 33 per cent., larger than given by the above rule. An engine with 18in. cylinders would thus have 17sq. ft. or so of grate area, 1080 to 1100sq. ft. of total heating surface, of which about 110sq. ft. is in the firebox; the least diameter of the chimney would be about 14½in. E. GOBERT.

South Tottenham, Sept. 26.

AN OLD BEAM ENGINE.

To the Editor of THE MECHANICAL WORLD.

SIR,—There is now standing at Park Bridge, about half-way between Oldham and Ashton-under-Lyne, an old beam engine somewhat analogous in design to the engines first made by Watt for pumping water from mines. This engine was probably employed for this purpose, as the chain from the beam leads down a shaft. By appearance it will date back to about 1800. The beam is of oak, mounted on stonework. The cylinder was supplied with steam from a haystack boiler, the plates of which are now so corroded and thin that the hand can almost be thrust through them. The brick chimney is covered with ivy, and the structure is a museum in itself. Photos. of the above are plentiful in the Oldham district, and scores of amateur engineers visit the place. If any reader can furnish an authentic account of the history of the engine, it would doubtless be interesting to many engineers.

Failsworth, Sept. 26. M. E.

Prize Competition.

WE OFFER FOUR GUINEAS MONTHLY IN PRIZES FOR THE BEST ORIGINAL ARTICLES SENT IN ON ANY MECHANICAL, ENGINEERING OR ELECTRICAL SUBJECT.

IN ORDER THAT MANAGERS, DRAUGHTSMEN, FOREMEN, AND WORKMEN WHO HAVE HAD NO PRACTICE IN WRITING MAY NOT HESITATE TO SEND IN COMPETITIONS, IT IS TO BE UNDERSTOOD THAT ALL ARTICLES WILL BE FULLY EDITED AND CORRECTED, AND JUDGED OF SOLELY ON THEIR MERITS AS ORIGINAL CONTRIBUTIONS FROM A PRACTICAL POINT OF VIEW. THE OBJECT OF THE COMPETITION IS TO INDUCE PRACTICAL MEN TO COME FORWARD AND GIVE THE RESULTS OF THEIR EXPERIENCE.

CONDITIONS.

Competitions for our Monthly Prizes must be sent so as to arrive at the Manchester Offices of THE MECHANICAL WORLD, New Bridge-street, not later than the last Tuesday in each month. Articles arriving after that time will be placed in the following month's competition.

Written competitions must be on one side of the paper only. The contributions must be original, and relate to matters connected with Engineering, Mechanism or Electricity.

The Proprietors of THE MECHANICAL WORLD reserve the right to publish any competition, whether it gains a prize or not.

The competitions may be accompanied by diagrams, sketches or drawings.

Competitors should write the words "Prize Competition" on the envelopes.

Competitors are not confined to one, but may send any number of competitions.

The correct name and address of the sender *must* be distinctly written upon every competition, not necessarily for publication. Competitions can appear under a *nom de plume*.

☞ We cannot undertake to be responsible for any MSS. sent to us, though when stamps are enclosed for the purpose we will endeavour to return rejected contributions.

Miscellaneous Items.

The East Goodwin Lightship is to be connected with Dover by telegraph.

An ascent of Ben Nevis has been made with a view to a survey of the proposed route of a railway to the summit.

The first locomotive ever made in Norway has been turned out at the Nyland Engineering Works, Christiania, for the State Railways. The cost was £2225.

The Swedish State Railways are having some of their locomotives altered in accordance with the American bogie system. Instead of six wheels their locomotives will in future have eight wheels, and the tenders six instead of four.

A new porcelain has been obtained by grinding asbestos to a fine powder, dissolving out all soluble matters with hydrochloric acid, making the powder into a paste with water, and baking it in a porcelain furnace for 18 hours at 1200°.

A concession has been granted for the first tramway in Sweden to be worked by electricity—viz., from Stockholm to Djursholm, a villa suburb. The maximum speed will be 12·6 miles an hour. There will only be one car, seating 40 persons, and it will run every quarter of an hour.

One of the most remarkable engines in the United States in point of length of service and efficiency in running, is at the works of the Corliss Steam Engine Company, Providence. It has a record of nearly fifty years of steady work, and to all appearances, is equal to a second half-century of driving. It is one of the earliest of the engines designed by the late George H. Corliss, and is of the type made familiar to thousands by the Centennial engine.

The total number of miles of railroad in the United States at the close of 1891 was 170,601, of which 4471 miles were constructed during the year.

The Hull and Barnsley Railway Company are about to commence a branch line from their main line between Hemsworth, South Kirkby Station, and Cudworth, to Denaby Main, Mexborough, so as to catch the mineral traffic which is likely to accrue from the opening up of the new collieries in the intermediate districts. The contract has been let to Messrs Joseph Fairbank and Sons, of the Railway Approach, London Bridge, London.

Much interest has been aroused in Staffordshire by the discussion at the Iron and Steel Institute respecting the conversion of ironworks slag into agricultural manure. In Staffordshire, where smelting has been carried on for over a century, millions of tons of slag from blast furnaces and puddling furnaces have been accumulated in huge mounds, which disfigure the surface and prevent the land being utilised for other purposes. For some time past Sir Alfred Hickman, at the Staffordshire Steel and Ingot Works, has been utilising the phosphorus from puddling-furnace slag, converted under the Thomas-Gilchrist process for steel making, for agricultural manure with complete success, but it had not occurred to the local ironmasters that the refuse from the blast furnaces contained a chemical product so valuable as a fertiliser.

Queries.

☞ Readers are invited to avail themselves of this section for practical information on questions relating to Mechanical Engineering and the Scientific Industries.

☞ Queries and Replies should arrive at the Manchester Office not later than by the first post on the Tuesday preceding the date of publication.

PLUMBERS' UNION.—Required the address of the secretary of the Operative Plumbers' Union.—PLUMBER.

WOOD PULP.—Can any correspondent inform me of any process for softening oak chips or shavings into a pulp?—R. C.

COATING FOR WATER PIPES.—Can any reader tell me how to ascertain whether cast-iron pipes have been properly coated with Dr. Smith's solution?—WATER PIPE.

MOULDING SAND.—Will any reader inform me where the fine moulding sand is obtained, the same as used for making small malleable iron castings in?—WALSALL IRON FOUNDER.

MARINE ENGINEERS' EXAMINATION.—Will any reader inform me of the qualifications of an engineer on board ship? How such situations are obtained, and particulars of examination?—A. G. K.

SPEED OF LOCOMOTIVES.—Provided a railway line is laid as perfect as possible, can any engine attain such a velocity as to cause it to leave the rails owing to excessive speed only?—P. T. G.

ROLLING CONTACT.—Can any reader kindly inform me if there are any machines in use for any purpose which have two rollers, cylinders, or the like, revolving in opposite directions at the *point of contact*?—W.

INJECTOR.—Will any engineer give me reliable data for calculating the quantity of steam it would require to work an injector that would lift 1000 gallons of water 10ft. high in one hour, into a tank or empty boiler?—G. A. B.

HOT-AIR ENGINE.—Will some reader of THE MECHANICAL WORLD kindly oblige me with a section and principal dimensions of a ½H.P. single-acting hot-air engine of the Stirling cycle?—GEO. H. PERKINS, North Queensland.

PEAT COAL.—I shall be very pleased if any reader of your valuable paper can give me some information on the above subject. I am desirous of knowing what firms manufacture it; its properties as a heating agent; what is its heating power in comparison with ordinary good coal; would it be a cheap fuel for firing boilers?—J. W. GEMMEL.

BOAT PROPULSION.—If a boat floats down a river, will it be carried forward at the same speed as the stream is flowing? Or can it be proved that it will go slower than the stream? How much force in lb. will be required to propel a boat of a given weight against a stream or up a river flowing with a certain velocity, so that the boat shall move up the river with the same speed that the stream is flowing down?—HYDRA.

CAMS AND BOWLS.—(1.) When subject to little pressure, studs work in the cam race without any roller or bowl on them. At what amount of pressure ought a roller to be used on the stud to work in the race? and how is the pressure on the stud to be calculated for a cam to turn rotary motion into to-and-fro straight motion if the groove or race is 12in. diameter and moves a bar 4½in. in each direction? (2.) What is the pressure on a wiper cam to lift 2cwt. at 1¾in. from shaft? and also, what is the strain on the cam shaft, and how can I find it for other wipers? (3.) What is the pressure on the ball bearing in a ball mill, and how is it found? The mill is to grind 75lb. at a time, and the ball works in a hemispherical footstep bearing and at end of inclined spindle, the top end of which makes a circle of 1ft. diameter in turning. Weight on spindle about 1 ton.—OATS.

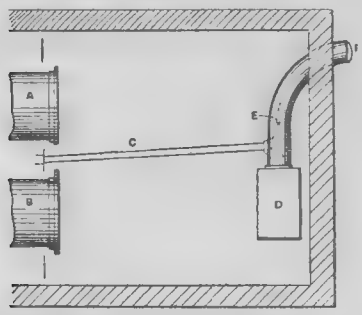
LOCOMOTIVE CONSTRUCTION.—Will any correspondent enlighten me as to the mode adopted in locomotive work in order to fix the position of the axles (horizontally) so that each axle may have a predetermined portion of the total weight resting upon it? Say:—

Load on leading axle	.....	0·32
,, driving ,,	.....	0·48
,, trailing ,,	.....	0·20
		1·00

Of course, I am aware there are certain circumstances—such as length of barrel, position of firebox, etc.—which in practice to a great extent influence this; but the point I wish clearing up is: Given the total weight, how are the positions of axles determined so that the prearranged weights rest on them? An answer would be of service to others as well as to—HILLSLAND.

Losses in Steel Furnaces. — Could any reader kindly inform me the average per cent. of actual loss, and the average per cent. of skull, in the charge of a Siemens open-hearth steel furnace working charges of from 30 to 40 tons? And also the percentage of loss in heating slabs and ingots in the Siemens regenerative gas furnace?—J. R. R.

Steam Jet.—Will any reader kindly enlighten me as to some plan for discharging ashes from the stoke-hole of a boiler house by means of a steam jet? My idea of such an arrangement will be best shown by the accompanying sketch, which is a plan of the front end of the boiler house. A and B are two Lancashire boilers, each about 28ft. × 7ft. diameter, and working at a pressure of 60lb. C, steam pipes from boilers ending in a nozzle E, which is inside the discharge pipes F. D is an iron box with a suitable air-tight lid. The ashes to be



discharged are emptied into the box D and the lid closed. Steam is then allowed to blow through the nozzle E. The suction thus caused is supposed to draw the ashes from D, which are then blown out through the discharge pipes F by the steam jet at E. In my case the vertical height from D to the point where the ashes would be discharged outside the boiler house would be about 13ft. A sketch with sizes of steam pipes, ashbox, and discharge pipes would greatly oblige.—G. A. B. M.

Replies.

☞ Owing to the constant increase in our correspondence, we regret that we have no alternative but to announce that we cannot reply by post to Queries even when stamped envelopes are sent.

☞ Queries and Replies must in all cases be accompanied by the names and addresses of the writers, as no notice will be taken of anonymous communications.

T. Maxwell.—Try Messrs. Martineau and Smith, Birmingham.

F. W. Henderson.—We intend to make use of your article shortly.

M. R.— Box's "Mill Gearing," 7s. 6d. It may be had from our office.

S. Colchly.—Yes; we believe the articles will be published in book form.

J. Weatherall. — The price of the book named is 4s. 6d. It may be had from our office.

G. A.—Messrs. Ley's Malleable Iron Co., Derby, will supply you with small castings of the kind named.

P. Anselm.—Messrs. Asher and Co., 13, Bedford-street, Covent Garden, will doubtless be able to supply you.

Engine Fitter.—Carefully draw-file the pin and fit new brasses, taking care that they do not bind at the sides.

T. S. F.—The Aluminium Reduction Syndicate Limited, Patricroft, near Manchester, will supply you with aluminium.

B. Baitherick.—We fail to understand your query. You will find a table of areas of circles in "The Mechanical World Pocket Diary."

Joseph Bull.—We cannot give you any particulars as to the nature of inventions for which provisional application has been made.

J. W. (Engineer). — Most of the wheels are stamped from sheet metal. A small wheel-cutting machine is used for more accurate work.

L. P. Piston.—There is no rule of the kind you refer to. It will depend upon the size of the piston and the condition of the bore of the cylinder.

Reader.—We think the address of the secretary of the Junior Engineering Society is Mr. Dunn, 124, Reedworth-street, Kennington, London.

Condenser.—Such an air condenser as you inquire for was illustrated in our issue for January 29, 1892. If this is not sufficient for your purpose, kindly let us know.

Learner.—It would take up a deal of space to fully answer your very elementary queries. Obtain a copy of "First Principles of Mechanical Engineering," 3s. 6d., which may be had from our office.

J. E. Bradley.—The following firms are large makers of bicycle fittings:—Messrs. T. Smith and Sons Limited, Saltley Mills, Adderley-road, Birmingham; and Messrs. T. Warwick and Sons, Alma-street, Birmingham.

W. Cooper.—As shown in the sketch, your coil would only act when the upper side of the piston was under pressure. We think the idea a practicable one, but better results could doubtless be obtained by simpler means.

Subscriber.—The question sent is one requiring due consideration at the hands of a patent expert. The claims of the specifications are the chief points to consider. The manager of our patents department will report upon the matter if you communicate with him.

Interested.—(1.) We have inserted a similar query to yours in this issue. (2.) One way to locate the second line is to measure off from the intersection of the two lines 10ft. along each. Then, when the diagonal distance between the two points thus obtained is 14ft. 1⅛in., the lines will be at right angles.

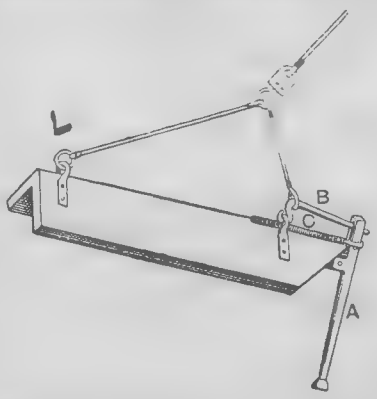
Boiler.—The fall of pressure would depend upon the amount of protection which the outer surface of the pipe is afforded, the number of bends and valves, dryness of the steam, etc. It is impossible to give any definite answer to such a question. There will certainly be a very decided fall of pressure in passing steam through such a length of pipe, but the degree of loss can only be determined by testing by gauges after the work is finished. You will find some matter of interest in this connection in our issue for May 25, 1889.

Inspector.—You can obtain all the information you require from Mr. G. Phillips, Oakham, who has published a book entitled "A Preparatory Course for Board of Trade Examination of Weights and Measures Inspectors."

Board of Trade Surveyors. — Can any reader of The Mechanical World give me any information respecting Board of Trade surveyors? How are the situations obtained, particulars of examinations, etc.?—Boiler Maker.——*A.*—In reply to "Boiler Maker," I do not think there is a book written on this subject solely; but he will find a great deal of information thereon in "A Handbook for Steam Users," by M. Powis Bale, published by Messrs. Longman at 2s. 6d.—E. S. Bishop.

Steel Castings.—Will any correspondent enlighten me as to the method of casting buffer boxes for railway vehicles in steel? What would be the best kind of pattern to use—wood or cast iron,—and would it require to be in two halves with core box? I should like the address of a firm that would undertake the making of such. Can they be cast in the open sand?—Engineer.——*A.*—Messrs. F. H. Lloyd and Co. Limited, James Bridge Steel Works, Wednesbury, and Mr. R. Limb, c/o Mr. Ludlum, Sharrow-lane, Sheffield, would like to communicate with you.

James' Patent Sounding Machine or Submarine Sentry.—Can any reader oblige with particulars of this apparatus, or name of makers?—J. P.——*A.*—A sketch of the sentry is given below. It is really an aquatic kite, and is composed of two boards nailed together as shown, and which are trailed behind a vessel at sea. The angle of the kite bridle regulates the depth at which the kite swims



below the surface of the water. If the sentry touches the bottom, the striker A releases the trigger B and the sentry turns over and floats, simply held in tow by loop L. I do not know the makers. The apparatus was on view at the Liverpool Naval Exhibition, and on the descriptive circular inquirers were referred to 18, Billiter-street, London.—Clarence.

Latest Inventions.

APPLICATIONS FOR LETTERS PATENT.

When Patents have been "communicated," the name of the communicating party is printed in italics.

Where complete specification accompanies application, an asterisk is suffixed

12th September, 1892.

16,271 Running Socket and Back Nut for Wrought-iron Pipes. W Lewis.
16,273 Self-sealing Gas Retort Mouthpieces. J F Bell.
16,280 Buffers for Railway Truck Tipping Cradles and Railway Sidings. A Hamilton.
16,281 Protecting Railway Signals. F B Hart.
16,282 Machinery for Flanging, Shaping, or Punching Metal Plates. A C Kirk.
16,284 Electric Call Bell Indicators. W Jennings, jun.
16,289 Water Heaters. J G Wagstaff.
16,292 Soldering Aluminium. O Nicolai and C Langenbach.
16,294 Adjustable Sliding Nut or Collar. L Huff.
16,300 Supplying Electricity to the Carbon Electrodes Employed in the Electrolysis of Fused Electrolytes. H H Frei.
16,301 Electrical Fire and Burglar Alarm Connections.* H T Wilson and N Schwab.
16,304 Machines for the Manufacture of Envelopes. E Pett.
16,308 Methods of Effecting a Continuous Circulation and Cooling of Cooling Liquids Employed in Motors and Compressors.* W Maybach.
16,309 Disengaging Gear for Machine Belts and Ropes. W Maybach.
16,310 Locomotive Cars.* W Maybach.
16,313 Multiple Drill Apparatus for Coal Getting and Tunnelling. G H Harrison.
16,315 Electric Telegraphs. F E W Bowen.
16,316 Rheostats.* H W Lawrence.
16,317 Railway Spike.* E A Streeter and B W Nichols.
16,321 Hand-power Tenoning Machine for Wood Working. R S Kelly.
16,322 Artificial Fuel.* C Winter.
16,326 Stuffing Boxes and Glands of Steam Engines, Pumps, etc. J S Starnes.
16,329 Furnace Grates. R Goll.

13th September, 1892.

16,330 Pile Wires.* C Ford.
16,333 Sewage Separating and Purifying Apparatus.* W F Goodhue and C Paulus.
16,335 Electric Telephones.* E M Harrison.
16,333 Danger (Alarm) Signal for use on Ships or for Shore Signals. T F Matthews and J Johnston.
16,339 Liquid Hydro-carbon Engines. S Griffin.
16,355 Percussive Apparatus for Riveting and Caulking.* J M Ross.
16,357 Machinery for Compressing Air and other Gases. W H Northcott.
16,364 Saw-filing Machines.* G Ott.
16,365 Lubricating Cup.* I J Briggs and A W Sanborn.
16,359 Apparatus for Simultaneously Burning both the Light and Heavy Portions of Vaporisable Oils at One Burner.* W P Thompson. (*G H Harvey and others*, United States.)
16,371 Electric Locomotives.* W H Soley and others.
16,379 Petroleum Motor Contrivance for Pressing the Petroleum into the Gasificator. O Brünler.
16,381 Petroleum Motor. O Brünler.
16,382 Cooling Device for Gas and Petroleum Motors. O Brünler.
16,391 Machines for Plaiting Wire.* O Freston.
16,394 Pipe Wrench. W W Horn. (*F B Ide*, United States.)
16,406 Apparatus for use in Ventilating.* C A Cowell.
16,407 Helical Propellers for Ships, also Applicable to Aerostats.* L A Boisset and O L Mercier.
16,408 Iron and Steel. G F Thomson.
16,413 Gas Engines.* G F Redfern. (*La Société Anonyme des Moteurs Thermiques Gardi*, France.)

14th September, 1892.

16,420 Compound Locomotives. W Monk. (*H Monk*, United States.)
16,425 Stone-planing Machine Tool. G H Greensmith.
16,427 Magneto Generator and Battery Switch Bells. G A Nussbaum.
16,432 Lock Nuts. A Fenton.
16,433 Automatic Release Pin for Railway Wagon Brakes. A J Savill.
16,434 Electric-light Switches, Cut-outs, Ceiling Plates, etc. C M Dornan and R A Smith.
16,435 Production of White Lead direct from Galena. P Bronner.
16,449 Joints or Couplings for Pipes or Tubes. J H Brindle.
16,451 Crushing or Grinding Mills. H J R Pamphillon.
16,453 Plug Taps or Valves. D Horsburgh and R Wood.
16,454 Gauge Glass Fittings for Steam Boilers. W Howson.
16,456 Ammeters and Voltmeters. E F Moy and F Teague.
16,458 Boring Machines. E T Hughes. (*V P Wilcox*, United States.)
16,461 Secondary Batteries. W Main.
16,463 Centrifugal Machines for Separating Liquids. R A Lister and M Pedersen.
16,468 Perspectograph. F W Golby. (*J H S Jechoux*, France.)
16,469 Contact Fittings for Movable Electric Lamps.* C E Webber.
16,470 Driving Mechanism for Locomotives Constructed with Bogies. C Hagans.
16,476 Apparatus for Obtaining Motive Power. H F McBride.

15th September, 1892.

16,483 Nuts and Bolts. J Bird.
16,486 Apparatus for Drawing, without any Knowledge of Perspective, any Object from Nature. K Gengndgel.
16,489 Arrangement for Working an Electrical Rock Drill. A L Taylor.
16,493 Marine Motor. R B Adams.
16,494 Furnishing Supports for Piston Rods or Shafts. N Macbeth.
16,505 Driving Belts. N Knowles and W Philipson.
16,508 Boilers and Furnaces. W H Greenwood.
16,514 Copper and Gunmetal Casings for Iron or Steel Shafts, Plungers, and Rolls. F E and A S Elmore.
16,516 Water-tube Steam Boilers. C S Galloway.
16,538 Marking Gauges or Scribing Blocks. T Falk and W Zeidler.

16th September, 1892.

16,545 Dry and other Galvanic Batteries. A E J Ball.
16,546 Cog-wheel Rudder. T Morris.
16,547 Boat Raising and Lowering Gear. H Bown.
16,549 Apparatus for Making Moulds for Casting. S Alley and J A MacLellan.
16,550 Electric Telegraphs. J F Hoffgaard. (*H P Fryd*, Denmark.)
16,558 Apparatus for Signalling on Railways. W Baker.
16,559 Leather-dressing Machinery. W Farrar.
16,561 Dynamo Electric Machines and Motors.* A W Meston.
16,568 Apparatus for Hydro-propulsion of Vessels. G Strickland (Count della Catena).
16,570 Apparatus for Electrical Propulsion of Vehicles. F E Elmore.
16,571 Improvements in the Connections of Electric Motors with the Sources of Electricity from which they are Supplied. Woodhouse and Rawson United Limited and W S Rawson.
16,572 Dies for Flanging Metal Plates. A C A Holzapfel.
16,574 Steam Generators. G Zahikian.
16,575 Fog-signal Gong. J W Haselden
16,578 Fog and other Signalling. W S Gratwick.
16,582 Treatment of Dust Deposited in Calcining Furnace or Flues to obtain Bismuth therefrom. A Kay.
16,588 Production of Oxygen and Hydrogen by Electrolysis of Water. P Garuti.
16,592 Apparatus for Concentrating Gold Ores. R H Grey. (*F W Grey and W Marsh*, India.)

17th September, 1892.

16,604 Lathe Turning Printing Plates. A Gray.
16,609 Supporting or Strengthening Pipes containing Liquid under Pressure. J McPhail.
16,615 Electric Incandescent Lamps. T Froggatt.
16,616 Valve. H Clayton.
16,624 Automatic Electric Winding Mechanism for Electricity Meters. G W Fairall.
16,625 Automatic Starting Gear. W G Buck.
16,629 Aluminium. W Mills.
16,641 Rotary Engines and Motors. F D Rose.
16,644 Instruments for Measuring Electrical Currents. Siemens Bros. and Co. Limited. (*Siemens and Halske*, Germany.)
16,649 Wood Screws. G H Evans.
16,652 Metallic Packing for Stuffing-boxes of Steam Engines and Pumps. J Allen and C B Crowe.
16,654 Apparatus for Hollowing or Channelling Wood. P S Brown and J Barr.
16,655 Milling Machines. H F L Orcutt. (*Ludwig, Loewe and Co.*, Germany.)
16,656 Electric Light Fittings. F W Plumstead
16,658 Railway Signalling Apparatus. G B Bayley.
16,659 Automatically Signalling the Proximity of Land, Sand Banks, and Reefs on Board Ship. J D Michell.
16,661 Adjustable Cranks. A Wilson.
16,663 Railway Signal Apparatus. J C G Mugnier.
16,665 Adjustable Moving Spanner and Screw Wrench. E T Cleathero.
16,670 Condensation of Steam or Vapour.* W R Lake. (*Sangerhäuser Actien-Maschinen fabrik und Eisengiesserei vorm. Hornung* and *Rabe*, and *F J Weiss*, Switzerland.)
16,674 Ship Locomotives. H de M Snell.

Manuscript Specifications of Patents can be examined at the Patent Office, London, after the Complete Specification has been accepted, on payment of 1s. The printed Specifications are usually published in about one month after acceptance of the Complete Specification, and any single copy may be obtained by remitting 8d. in stamps (or by special post cards sold at the Post Offices at 8d. each) to Sir H. Reader Lack, *Comptroller General, Patent Office, 25, Southampton Buildings, Chancery-lane, London. When a number of Specifications are required, remittances may be made by P.O.O.*

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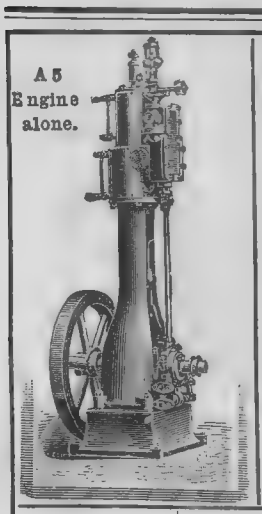

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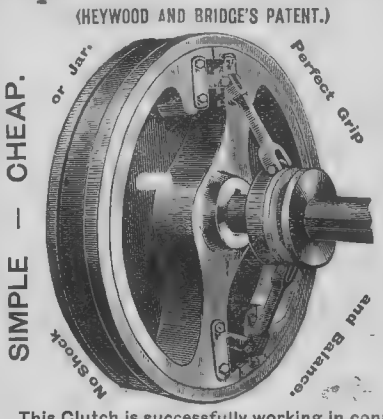

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FACTS FOR ADVERTISERS.

A TON AND A HALF OF PAPER is now used every week in the production of THE MECHANICAL WORLD, three-quarters of a ton being despatched to the London Office (391, Strand) for distribution throughout the Metropolis, and the Southern and Home Counties and abroad, by the London wholesale newsagents. The other three-quarters of a ton are similarly distributed throughout the Midland and Northern Counties, Scotland, and Wales.

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FRIDAY, OCTOBER 7TH, 1892.

The Gullibility of Inventors.

GENERALLY speaking, inventors may be said to comprise a more than ordinarily "smart" section of the community, but it is nevertheless a fact that among their number are to be found some of the most gullible of mankind. We do not refer, be it understood, to those inventors who have so successfully acquired the art of self-deception as to be daily expecting to discover the one missing link required to perfect some apparently feasible scheme for the production of perpetual motion or the creation of motive power. Inventors of this class are, as a rule, altogether beyond redemption, and if only they were victimised by the unscrupulous, it would not be a very surprising matter. But, as a matter of fact, we find scores of inventors, many of whom are shrewd business men in their way—men who, in some instances, have grappled successfully with some more than ordinarily difficult problem, and yet are most easily deceived by devices which one might expect the most unwary individual to immediately see through. For some time past hundreds of patentees, both in this country and America, have received an intimation to the effect that the Parisian Inventors' Academy has conferred upon them the title of Honorary Members with the award of the first-class diploma for their latest inventions, together with the great gold medal (gilded). In immediate connection with this announcement is the information that the "honourable title" will be conferred free of charge, but that if the happy inventor desires to become the possessor of the medal and diploma a charge of £2 will be made. Doubtless many of our readers have been recipients of communications from the Parisian Inventors' Academy, and probably in several instances the transaction has had a *bonâ-fide* appearance. But when it is considered that in the majority of cases inventors are awarded this "honorific" title when only an application for a patent has been filed, and when *no particulars of their invention are obtainable by outsiders*, it will be seen how great a compliment the Parisian Academy seeks to confer. We have been prompted to make these remarks not only for the benefit of present and future "honourable members" of the Parisian Inventors' Academy, but also for the information of some of our sixpenny contemporaries, one of whom in its last issue announces with due solemnity that a certain gentleman has had this distinction conferred upon him. We can excuse the appearance of such an announcement in a local newspaper, but in one of our "high-class" contemporaries it seems sadly out of place.

New Electric Signal.

AT a recent meeting of the International Society of Electricians in Paris, M. H. Pellat described a train speed indicator and a system of signalling for the prevention of collisions. The first is based on the principle of receiving on a special apparatus the indications furnished by the passage of an electric current from separate circuits dependent upon contacts placed at suitable intervals along the line. These contacts are arranged in front and in the rear of a central station occupying the middle of the section where the recording or receiving apparatus is fixed, and may be arranged as ordinary pedals. The circuit is closed by the passing of a train over one of these contacts, a separate circuit being provided for each contact, while a separate organ for each contact is contained in the receiving apparatus. The records are made on paper placed on a drum, by means of small platinum needles arranged in front of the drum. When a current passes through one of these needles, a point or dot is impressed into the paper; this becomes an arrow when the train is travelling at its lowest speed; it becomes a line when the train from one cause or another remains upon a contact. The other trains in the section similarly record, and thus the employé in charge of the recorder is able to determine their respective positions at any moment. This employé can also, by the use of a switch, a special circuit and relay, give the drivers of the trains warning not to proceed any farther in case of necessity, this being accomplished by the current closing the circuit of the relay which controls the whistle on the locomotive. This is the second part of the system, which it is expected will greatly tend to prevent collisions.

Electric Lighting in Paris.

IT appears that Paris is behind Berlin and London in the matter of electric lighting, notwithstanding the various central stations in that city. Out of the 85,000 houses in Paris, only 20,000 are illuminated with gas, the consumption of which amounted last year to 283 millions of cubic metres. With regard to the central electric light stations, the present capacity is 17,500H.P., but when the stations are fully equipped the output will be increased to 32,000H.P. The number of lamps now in use is equivalent to 175,000 incandescent lights.

A New Feed-water Evaporator.

INCREASING attention is now being given to the evaporation of fresh from sea water for making up the supplementary feed for the boilers on shipboard, and various types of feed-water evaporators have been placed upon the market, which have proved more or less successful. One of the latest of these appliances is due to Mr. T. Mudd, the well-known marine engineer, and it is now being manufactured at the Central Marine Engine Works, West Hartlepool. Mr. Mudd contends that one of the most important requisites in an apparatus of this kind is that the heating surface should be very easily withdrawn into a position suitable for cleaning and overhaul. This has been completely carried out in this apparatus. The whole of the heating tubes are attached to a door, which door is hung upon a hinge. The tubes are curved, and the lower part of the shell of the apparatus is similarly curved, so that the heating surface is entirely withdrawn by swinging out the door upon its hinge, and by hooking it up it remains secure in that position till all cleaning operations are carried out. There is no joint to break, except the flange joint of the door, and the whole operation is carried out in the simplest and most speedy manner possible. The barrel is enlarged at a proper height so as to give a large ebullition surface, and thus increase the speed of evaporation. The shell stands vertically, and is made high in proportion, the steam of evaporation being carried off at the top. This assists the apparatus in the production of dry steam, and to further tend to this end the shell is fitted with a number of coarse and fine baffle plates so placed as to riddle the steam thoroughly on its way to the outlet. It can thus be relied upon to produce fresh water, and not to send over by means of priming a quantity of salt water, as is sometimes the case with these appliances. At present these evaporators are made in three sizes, the smallest for vessels up to about 750I.H.P., the middle size taking from that up to 1100I.H.P., and the largest from 1100 to 1800I.H.P. As the design is the outcome of a large experience with other types of evaporators, it will probably be found to fulfil its intended purpose with every satisfaction.

A Bicycle Railroad.

THERE has lately been opened in America a bicycle railroad, connecting Mount Holley with Smithville (N.J.). The road is two miles long. One or two persons can ride on a machine, and a novice can easily propel one a mile in four minutes. This railroad is described as a fence, on the top rail of which the bicycles run, propelled by the passenger, who pays a fare for the privilege. Guide wheels pressing against the side of one of the lower rails prevent the bicycle from turning over, so that no experience is required to ride them. The rider sits just high enough to clear the fence, so that the centre of gravity of the machine and rider is considerably below the centres of the wheels. The road runs through a romantic region, so that where the grade is not ascending the passenger can enjoy the scenery.

Scotch Shipbuilding in September.

NO improvement is manifested in the condition of the Scotch shipbuilding trade, which remains in an exceedingly depressed condition. During the month Scotch shipbuilders launched 30 vessels of 46,385 tons, of which 17, representing 25,034 tons, were steamers, and 13, measuring 21,351 tons, sailing vessels. To the total the Clyde contributed 13 steamers of 20,260 tons, and 12 sailing vessels of 18,495 tons; the Forth, a steamer of 550 tons; the Tay, two steamers of 4080 tons and a sailing ship of 2856 tons; and the Dee, a steam trawler of 144 tons. The production of September, 1891, was 27,470 tons. The vessels launched included a twin-screw steel steamer of 12,500 tons, built at Fairfield for the Cunard Company; a steel screw steamer of 4000 tons, built by Messrs. Gourlay Brothers and Co., of Dundee, for Messrs. W. Thomson and Co., of the same port; a steel screw steamer of 3600 tons, built by Messrs. Scott and Co., Greenock, for the Ocean Steamship Company, Liverpool; a steel barque of 2856 tons, built by Messrs. Alexander Stephen and Sons, Dundee, for their own general trade; a four-masted steel barque of 2825 tons, built by Messrs. Mackie and Thomson, Govan, for Messrs. Andrew Weir and Co., Glasgow; a steel barque of 2650 tons, built by Messrs. Barclay, Curle and Co. Ltd., for Mr. Robert Hill, Greenock; and a steel barque of 2500 tons, built by Messrs. Russell and Co., Greenock, to the order of Mr. A. F. Smith, Svedestrand, Norway. Of the total tonnage, 14,919 were for Clyde ports, 9236 for Scotch East Coast ports, 16,570 for Liverpool, 144 for North Shields, 400 for France, 2500 for Norway, 900 for South and Central America, and 600 for India. The inclusion of the "Campania's" tonnage in the Clyde total lifts it above the average. There were launched 25 vessels of 38,755 tons, of which 13, representing 20,260 tons, were steamers, and 12, measuring 18,495, sailing vessels. To the total Rutherglen contributed 16 tons; Govan and Whiteinch, 22,795; Renfrew and Paisley, 2600; Kirkintilloch, about 150; Dumbarton, 800; Greenock and Port-Glasgow, 11,844; Ardrossan, 409; and Ayr, 150.

Society of Engineers.

AT a meeting of the Society of Engineers, held at the Town Hall, Westminster, on Monday evening, 3rd October, Mr. Joseph William Wilson, jun., president, in the chair, a paper was read by Mr. B. A. Miller on "The Cleansing and Ventilation of Pipe Sewers."

The author having mentioned the difficulties which had been experienced in many towns sewered on the combined system, owing to the road detritus being washed into the sewers through inattention to gully cleansing, drew attention to the necessity of constant flushing to prevent the generation of sewer gas, due to the decomposition of deposited matter; he further stated that sewerage systems, though well designed and carried out, were often rendered incomplete owing to faulty house connections and insufficient water supply.

He then compared the systems of combined and separate sewering, giving the following reasons for preferring the latter:—Smaller sewers are required; surface water drains need not be laid as deep as sewers; the exclusion of surface water gives less liquid to deal with and be treated; there is greater regularity in the flow, enabling the size of sewers to be calculated more accurately; the sewers, being smaller, afford less space as gas-holders, and require less water to flush. He recommended the admission of roof-water into the sewers, as simplifying the arrangement of drains.

He then alluded to flushing, giving the different methods employed. The use of penstocks or plugs, causing the sewage to back up, he considered unsatisfactory, as deposits are left in the pipe to decompose. In preference he advocated the adoption of flushing chambers, containing automatic syphons, mentioning those of Messrs. Doulton, Rogers, Field, Adams, and Palmer, and proceeded to describe their action, giving preference to those with a deep trap.

Passing to the question of ventilation, he stated that provision should be made to prevent sewer gas passing directly into the air we breathe, and proceeded to enumerate the different methods employed for ventilating sewers, describing first the usual method by shafts from the sewer to the street level, with open gratings in the roadway, intended to act as outlets and inlets, but which were often an annoyance owing to the irregularity of their action. Briefly mentioning the use of charcoal filters, and the utilisation of chimney shafts, he described the Holman-Keeling sewer-gas destructor, which he considered effective though costly, and suggested the erection of iron shafts, either open at the top or provided with cowls, which would take the place of street lamps, placed on the line of kerb and connected with the sewer.

The author then gave a description of a series of experiments taken in one of these shafts at Beckenham, with a view of ascertaining the advantage of ventilating sewers by ventilating lamp-posts, as compared with the ordinary method of gratings in the roadway. The results of these experiments were embodied in a series of tables and charts, and by their means the author showed that the best results were obtained when the street ventilators were open; and further, that the direction of the wind was the chief agent which influenced the movement of sewer air in the shaft, the temperature also affecting it under certain conditions.

In concluding, he recommended, in order to keep sewers in their proper state, periodical flushing by automatic chambers and an efficient method of ventilating by ventilating-posts, which he considered would produce a better current of air in the sewers than is obtained by the ordinary method of street openings alone.

The paper was well illustrated by diagrams showing the various systems advocated.

The "Wasteless" Battery Zinc.

Owing to the fact that the zinc electrode must be removed before it is entirely consumed, a large waste of zinc takes place in all ordinary forms of batteries. Hitherto no practical or economical remedy has been found to entirely avoid this waste, which in the case of the best patterns of zinc for gravity batteries often reaches 45 per cent. of the total weight of zinc purchased (1¼lb. being wasted out of 3¼lb. of zinc).

In many places the stumps which constitute the waste cannot be used to any advantage, nor sold for want of a purchaser, and it would not pay to gather them and to ship them to a place where they could be disposed of. In frequent cases—that of telegraph companies, for instance—but about 20 per cent. of the stumps can be gathered (with trouble and expense) from scattered and distant places,

The "Wasteless" Battery Zinc.—Fig. 2.

as proved by actual experience. The stumps, even when all are collected, can at best be sold as impure metal at but about half the price of spelter.

The object of the "Wasteless" zinc, which is the invention of M. Georges d'Infreville, of 434, Canal-street, New York City, is mainly to avoid waste of the zinc. This invention consists in using for the zinc electrode a number of pieces adapted to be connected to one another in a column by joints or connections which are liquid tight or adapted to preserve the connecting parts from the action of the battery liquid, so that a partially consumed piece may be connected or attached to the bottom of a fresh or new piece, which latter, after being partially consumed, and after the still greater state of consumption of the first one, may, in its turn, be connected under and to a new piece, and so on.

This is shown in Fig. 1, which represents one complete gravity element fitted up with the "Wasteless" zinc electrode.

Fig. 2 is a cut of the three pieces constituting the said zinc electrode, showing their relative positions, and, as far as can be done by a cut, their comparative sizes, due to the state of corrosion of the two lower pieces, which depends on the length of time they have been in use.

The guarding against corrosion from the solution is also perfectly secure, as the socket below each zinc is, in fact, an inverted cup, and cannot allow, any more than a diving bell would, the access of liquid against its inside walls.

The conical stud or shank above and the conical socket below each "Wasteless" zinc is a simpler and cheaper method than connecting them by a screw thread, which is, however, also shown in the patent.

Fig. 1.

With two "Wasteless" zincs, one under the other, and a stump below them in the same jar (Figs. 1 and 2), the internal resistance falls to 0·7 ohm per cell (the electromotive force being 1·07 volts, as usual), giving a current of 1½ ampères; they are, therefore, well suited for operating circuits of moderately low resistance, such as local telegraph circuits, for electroplating, and the working of small motors.

The zinc is at present made only for the standard and most generally-used glass jar, which measures 6in. in diameter and 8in. in height.

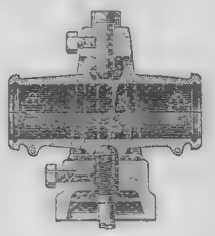
Wynne's Patent Adjustable Shaft Bearings.

The accompanying illustration shows an improved self-pivoting bearing applied to a plummer block, which entirely prevents any tendency to heat from want of alignment in the bearings, as the whole bearing is so supported that it adjusts itself to the shaft until the pressure is alike on every part of its length.

The weight of the shaft is taken by the rounded point of a mild steel setscrew, which enters a recess cast in the lower brass.

A longitudinal groove is cast in the upper brass of such section that the point of the upper controlling pin fits it in one direction, but allows the brass to have a free rocking motion in the direction of its own length by working upon the point of the lower setscrew. To permit this rocking to take place, the groove is curved lengthwise to a radius struck from a point of the lower setscrew. In the large sizes the upper pin is screwed into its place, but a plain mild steel pin is used for the small sizes, locked in position by a cup-ended steel setscrew.

It will be noticed that by unscrewing two setscrews the top of the bearing can be lifted away and the brasses removed, or the soleplate can be removed without in any way disturbing the shaft. Variations in the height of the bearings can be quickly made, and much time is thus saved compared to that wasted by the old method of packing up the plummer blocks with pieces of wood. It is claimed that 75 per cent. of the time



usually taken in erecting shaft bearings is saved in adjusting. It is also claimed that they cost less to manufacture than the American pattern of ball and socketed bearings, as ordinary mild steel setscrews replace the specially-screwed and turned sleeves used in the Sellars type of bearing. Builders of dynamos, fans, etc., will doubtless find several points about these bearings well worthy of their careful consideration, especially in cases where the armature or fan is directly coupled to the engine shaft.

In belt-driven dynamos, the facilities offered by these adjustable bearings for altering the relative position of the armature to the field magnets will also be appreciated by those in the testing room, when it is remembered that obstinate cases of sparking at the brushes are frequently only caused by a want of balance in the strength of the magnetic field between the armature and the field magnet. This want of balance can be adjusted by slightly raising or lowering the armature, and this can be done while the machine is in motion.

These bearings are made by Messrs. Wynne and Barnard, of Newcastle-on-Tyne, who desire to dispose of the patent rights. Terms and other particulars may be had on application to the manager of our patents department.

Institute of Marine Engineers.

A meeting of the Institute of Marine Engineers was held at 58, Romford-road, Stratford, on Monday, 26th ult., presided over by Mr. A. W. Robertson, vice-president, when the discussion on the "Treatment of Boilers," a paper read a fortnight previously at Gresham College, was resumed. The following members took part: Messrs. Johnston, Smith, Graham, Leslie, Adamson, Lilly, Sage, the chairman and others, who dealt with the various points raised in the paper, notably the action of zinc, and means of minimising the amount of cold air admitted to the back end of the furnaces. Allusion was also made to a system of circulation of the water by which the racking strains due to the difference of temperature between the upper and lower parts of the boiler were reduced. A passing reference was made to some of the earlier types of boilers which had worked satisfactorily without either the use of zinc or soda. A defective circulation was admitted to be a fault more with old boilers than with new ones. On the motion of Mr. Thomson, the discussion was arranged to be continued on Monday, October 3. It was announced that the second annual dinner of the Bristol Channel Centre would be held at Cardiff on October 8. The proceedings terminated with the usual vote of thanks.

Engineering Pattern Making.

By a Foreman.

XXV.

We shall now describe the construction of a pattern made up from the several materials previously mentioned. The panels, which may consist of a pastoral, allegorical, or floral design, will, for moulding purposes, be found most suitable in "bas" or low relief, as the more prominent alto-relief presents a deeper lift, and frequently the figure would require modifying so that no undercut part would present any opposition to an easy withdrawal from the sand. The subject of the panel being determined, a modelling board, made of 1½in. pine, with a couple of good battens at the back to stiffen it, should have a few coats of shellac varnish laid over the face to prevent the absorption of the water from the clay, and consequent drying and cracking, before the model is finished. It should be set on a pair of tressles, at a convenient height—between 2ft. 9in. and 3ft. will be found the best,—and should be placed in such a position that a good light is obtained, and at the same time space provided for free movement round the board.

We do not assume for a moment that the majority of pattern makers can model—in fact, this part of the business is confined to a limited number; but our object is to impart information that will enable the younger members of the trade who are inclined to be observant and devote some little time to the study of form, to acquire a knowledge, if only elementary, of a branch that will be of decided advantage, even in general work, where plaster at times may be substituted with advantage.

The clay being of the proper consistency, a sufficient quantity is placed upon the modelling board, and the operator proceeds to form the figure by moulding and pressing the clay into the shape desired, and using the fingers and tools alternately, reference to a drawing or sketch from time to time assisting in the conformation. From various causes it is not always convenient to finish the subject before the clay would become too stiff to work easily; this, however, can be prevented by throwing a damp cloth over the work whenever it is necessary to leave it for a time.

On completion, the model may be removed from the board by means of a piece of fine wire, the ends of which should be held in each hand while it is drawn between the clay and the board; this, of course, after the clay has set firm enough to prevent its damage by the operation, which is only required when it is intended to cast a metal duplicate, using the clay model for the pattern to be moulded from. When, however, it is intended to run plaster on the clay, it may be removed after the plaster has set, the clay being picked or washed out afterwards.

The casting of the "compo" metal pattern is usually entrusted to the pattern moulder, who at the same time "embosses" or lightens out the pattern, leaving it the desired thickness, by the following method: The clay or plaster model having been fastened by a few screws to a level board 2in. or 3in. larger than the moulding box in which it is intended to mould it, a small piece of wood planed to the desired thickness of the "embossing" is placed under each corner of the box, and a little facing sand sifted over the surface of the model. The moulding box is then filled in with black sand which is rammed hard, the box turned over, and the model withdrawn. It will be obvious to the reader that the placing of the pieces under the corners of the box will leave the surface of the sand the same height above the edge of the box as the thickness of the pieces; and it is this excess of sand that is cut or strickled off down to the edge of the moulding box, and after this operation it is ready, when freely sprinkled with parting-sand, to have a top part placed over it, and a layer of facing sand sifted on to the box part, rammed up with black sand, then taken apart, thus leaving a projection of sand representing or equalling the metal to be removed in the metal pattern. This part of the mould is now brushed or blown clean with the bellows and dusted with flour; it is also provided for the running by a "git" cut through with a tube pushed through the sand in the box and a narrow channel from this to the edge of the plate or panel. The second part of the mould or bottom part has now to be made by again ramming up the *first* box part which has

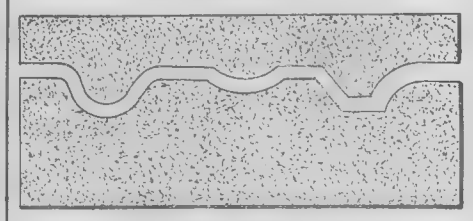
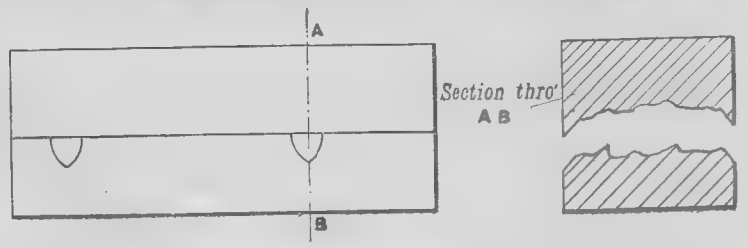


Fig. 164.

been "knocked out" as being of no further use, and this time it is placed over the model, but *without* the pieces under the corners, the same relative position to the top part being secured by the pins of the box fitting holes in the board to which the model is affixed. The same process is gone through as above described, with the exception of the ramming, which must not be *hard*, as this would have a tendency to make a "scabbed" or rough casting, and consequently a greater amount of labour to the chaser, as the object of the first part being rammed hard is to allow of a top part being rammed on it without affecting its form to any appreciable extent.

Fig. 164 will explain the process of embossing by raising the edges of the moulding box as previously described, but a different method is adopted when the panel or design is modelled on a plaster slab, and from which a wax pattern is to be made. The object of using this material is that it can, unlike plaster, be worked up again. The plaster slab being of no particular thickness, but sufficiently strong to be handled, is, after the design is finished (either by cutting or casting from modelled clay) covered all over to the required thickness of the wax pattern with pieces of modelling clay rolled out on a level plate or board by means of a roller working on two strips of wood, or preferably metal, set parallel with each other and a few inches nearer than the extreme length of the roller; this gives a uniform thickness corresponding to the thickness of the strips and equal to that required for the wax cast.

The rolled clay is then cut into small pieces, and gently pressed over the whole of the surface of the plaster slab, with the exception of an inch or two which forms the margin, and also the joint line of the mould, on the outside edges of which are



Engineering Pattern Making.—Fig. 165.

also cut three or four recesses, as shown at Fig. 165. These are for the purpose of keeping the top part of the plaster mould in a relative position to the bottom, as the pins in a moulding box. The rolled clay having been placed over the plaster surface, the next operation is to run a top part of plaster, and, as in the case of the bottom part, the face of this should be run with fine plaster, carefully mixed so that all air bubbles are excluded, as these, if left in by careless mixing, leave holes in the cast, and so destroy the smoothness and fine lines of the surface. To make up the requisite thickness and strength, coarser plaster may be used, and frequently old broken pieces are run up along with the fluid to form the backing of either half. In the course of a few hours the top and bottom may be separated and the clay picked out, and when the parts are again put together it will be obvious that a cavity

exists between the top and bottom slabs of plaster. Provision must be made for running the wax by cutting a wedge-shaped channel leading to the mould. This wax, like the compo metal, is somewhat misnamed, it being in reality a mixture of beeswax and resin, with the addition of a little tallow.

(*To be continued.*)

Sugar-making Machinery.—XX.

[ALL RIGHTS RESERVED.]

Mill Rollers and Shafts.—The proportions of the shafts and rollers which have been given have been arrived at by experience of the working of sugar-mill rollers over many years, and they represent what are probably the best proportions between the gudgeons and roller cases. When it is considered what enormous pressure may be brought to bear on sugar-mill rolls, the difficulty of striking

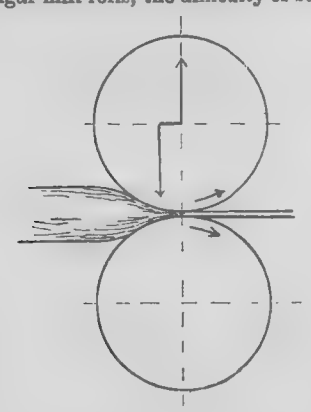


FIG. 37.

the balance between the strength of the gudgeons and the roller cases so that the one may be as strong as the other, will be readily understood. The part which is most liable to fail is the shaft or "gudgeon" close up to the roller eye, but sometimes it may fail within the roller. This is doubtless due to the fact that the enormous pressure on the bearings, which is as high as 1200lb. to 1500lb. per square inch, and even higher, gradually rolls out the metal of the eye of the roller case, eventually permitting the shaft to bend somewhat. With every revolution thereafter the shaft is gradually bent back and forth, and this continual reversal of stress ultimately ruptures the shaft. In an interesting article in the "Engineer" for November 29, 1889, on the fracture of sugar-mill rolls, this aspect of the question is investigated in a thoughtful way, and some of the remarks there made may be usefully quoted here. After suggesting how these failures might be remedied, the writer remarks that "prior to the increased attention given to this subject in recent years, owing to the increased number of failures, it was commonly held—as, indeed, it still is by some—that they were due to

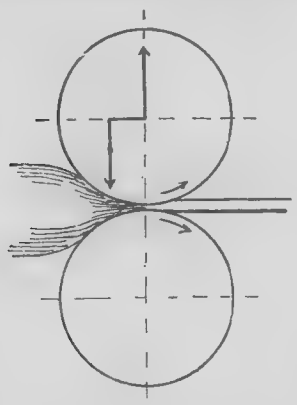


FIG. 38.

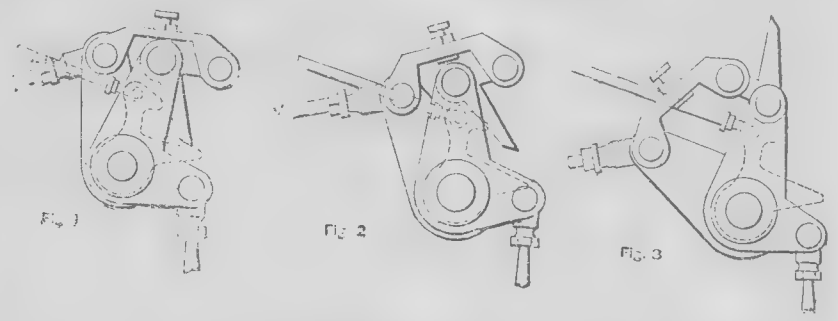
torsion, and could therefore be prevented by limiting the power driving the mill. Even on the present assumption, this would still be feasible *if* the bending stresses bore a constant proportion to the torsion; but this is not the case. With a given turning moment, the force tendency to separate the rollers is greater with a thin than with a thick feed. The thin feed may be likened to a long thin wedge drawn into the revolving rollers, and the thick feed to a short blunt one. Neglecting journal friction, it is evident that we have only to make the wedge fine enough to obtain as powerful a separative action as desired, theoretically up to infinity." Another way of looking at it is indicated in Figs. 37 and 38, the former representing a thin and the latter a thick feed. With the thin feed the arm of the couple resisting the turning effort is seen to be shorter than with the thick feed, and the turning moment being constant, the separating force must be correspondingly greater. It would have been interesting to obtain some idea of the magnitude of the stresses coming on the rollers, and causing so many to succumb, but as long as they ran in rigid bearings there was no way of estimating the pressure. The bearings were adjusted as closely as the power of the engine would allow with an average feed of canes, the only yield being that due to the stretch of the bolts and framing. If the feed was accidentally increased—and it was practically impossible to keep it uniform,—the mill choked, and the engine pulled up; and if reduced the crushing was inefficient. It is true that some very old mills of small dimensions, still in existence, are provided with levers and weights, or spring beams, for loading the journals; but these arrangements went out of use, as the pressures employed became greater than could be conveniently controlled by such means.

Whilst we are thus unable to estimate the pressure which a given driving power will produce on a roller running in rigid bearings, we have during the last few years obtained some information as to the pressure needed to crush canes. For this we are principally indebted to Mr. D. Stewart, a well-known maker of sugar plant, who some years ago patented and introduced the use of hydraulic rams for applying the necessary pressure on the bearings; and more recently, a simpler arrangement, specially suited to the smaller sizes of mills, has been introduced, consisting of toggle levers acted on by volute springs such as are used for railway buffers. (Both of these arrangements will be illustrated later.) The object of both these designs is to maintain a constant prearranged load on the journals, notwithstanding any variation in the thickness of the feed, thereby, on the one hand, securing the roller shaft against undue stresses, and, on the other, ensuring uniformly efficient crushing. A very small range of motion is sufficient to effect this, as will be understood from the fact that even in a large mill taking a feed of canes some 18in. deep, the space between the last roller is not more than about ⅛in., and it is not an uncommon method to set the rollers metal to metal, leaving the spring of the bolts and framing to provide the opening. A large number of mills have been fitted with one or other of these appliances, and the principle on which they act commends itself as decidedly correct. In practice it is found, as might be expected, that where they are in use the power exerted by the engine remains practically constant, whilst without them it varies over a wide range, giving at times an injuriously heavy stress, and yet on the average only reaching a low power, with a correspondingly low efficiency. This point is curiously confirmed by the increased wear of the intermediate gearing experienced in mills fitted with the appliances referred to, due, without doubt, to the constant performance of a high, though not excessive duty. The patentee of the hydraulic apparatus referred to has given the loading he adopts—*vide* "Sugar Cane," December, 1886—as three tons per lineal inch of roller's length. This rule is, no doubt, based on considerable experience, but it can evidently be applicable over but a limited range of sizes most commonly used, say rollers from 28in. to 32in. diameter. "Now there is no practical limit to the pressure which it is desirable to put on the canes other than that due to the limited strength of the mill as a machine." (The truth of this remark is very questionable, and does not appear to be borne out by other authorities, as we shall show later.) "Of this machine the weak point is almost invariably the rollers, and they are the only parts which cannot be strengthened to any desired extent by adding more material, the dimensions of their shafts being obviously limited for each diameter of roller. It, therefore, seems desirable to proportion the loading to the strength of these shafts, making it as great as they can be expected to resist for a practically unlimited number of repetitions or revolutions." "In practice it will be found convenient to state the load on the journal in lb. per sq. in. of journal surface ($d \times l$), although the load as stated will only bear a constant proportion to the stress on the material of the shaft, with a constant proportion of diameter to length of journal, and distance from centre of same to the point of support in the roller case. These proportions are, however, so nearly constant in practice as to allow this method to be adopted without serious error. Looking at it in this way, the writer has in several instances adopted a load of 1500lb. per sq. in. of journal surface, corresponding with a stress on the material of the shaft of about 7½ tons per sq. in., and, assuming the shaft to be iron and perfect, a margin of safety of 1·133. In this calculation the leverage against the shaft has been arbitrarily taken as the distance from the centre of the journal to the end of the roller case, plus half the bore of the latter."

(*To be continued.*)

Detachable Valve Gearing.

THE illustrations show a new form of trip gear for Corliss and similar engines. The lower rod at the left in the several



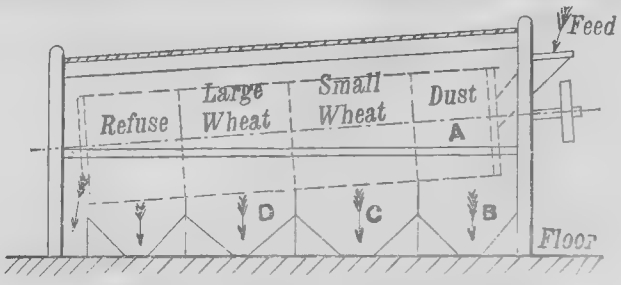
IMPROVED TRIP VALVE GEAR.

views of this valve gear is connected with the wristplate, the upper one with the governor, while the dashpot rod is shown at the bottom. The wristplate rod is connected to an arm loosely mounted on the valve stem, and also, by means of a curved link, with the short arm of a bell-crank lever, which latter is pivoted on the long arm of a larger bell-crank lever fixed on the valve stem. When the gear is in the position shown in Fig. 1, the three upper pivots being in line (as adjusted by the set screw in the link), all the parts move together, so that the valve stem is turned by the pull of the wristplate rod till it reaches the position shown in Fig. 2. At that point the lower arm of the small bell-crank strikes a tripping piece (shown in dotted outline) mounted loosely on the stem, the position of which is controlled by the governor rod. Further movement trips the bell-crank, throwing the pivots out of line, and releasing the gear, as shown in Fig. 3, when the valve is closed by the dashpot. It will be seen that as the position of the tripping device is controlled by the governor, the time of cut-off depends directly upon the speed of the engine. This valve gear is the subject of an American patent.

The Design and Erection of Flour Mills on the Roller System.—XVII.

THE wheat, after leaving the magnetic separator, is passed on to the wheat grader or separating machine, which machine not only divides the wheat into two grades—viz., large and small,—but also separates from the wheat a large percentage of refuse or rubbish, such as barley, oats, cockle and other seeds. Under the heading of "Storage of Grain and Silo Arrangement," this machine was briefly noticed as a warehouse separator, making a rough separation of wheat and seeds. In that case the separation was to prevent as much as possible the storage of rubbish, etc., but now this machine must be considered as an indispensable link in the wheat-cleaning arrangement.

The old-fashioned wheat separator consisted of an inclined cylinder having a perforated steel clothing. The cylinder was about 40in. diameter, from 6ft. to 8ft. long, and made from 20 to 30 revolutions per minute. The cylinder was enclosed in a timber case, Fig. 19. Such machines have done good work in their time, and



DESIGN AND ERECTION OF FLOUR MILLS.—FIG. 19.

required little power and no attention, but they were very dirty machines, and unless the timber-work was very well put together, a lot of dust escaped. Again, it will be seen that as the dust and very small seeds pass through the head end sheet marked A, and this discharge is supposed to settle in hopper B, it is evident that the light dust raised by the movement of the machine can travel all over the machine and consequently pass with the wheat through C and D hoppers. So far from being free from dust, the wheat is sometimes as dirty as if no attempt at cleaning had been made. All that was required to make this machine turn out better work, was to draw away the dust-laden air in the machine by means of a fan, and to exhaust into the dust or stive rooms. It must not be forgotten that air currents properly directed and fully under control, form the most essential part of the principal wheat-cleaning machines.

The modern wheat separator does its work by means of sieves having a perforated covering; there is also a powerful exhaust fan attached to draw away the dust and light seeds. The sieves are driven by a crank, or are given a rotary motion. At the present time the rotary-motion system takes the lead, but as both motions give good results, there is on this point not much to choose. The writer prefers the sieves driven by balanced cranks, or, as they are called in the mill, "balanced sieves," for the reason that there is hardly any vibration and an absence of

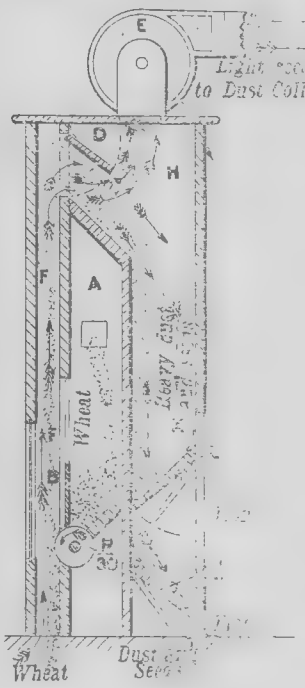


FIG. 20.

all sudden jerks. It should be pointed out that the idea of balancing the sieves is patented, and not long ago there was an expensive lawsuit on this point, and milling engineers, finding that balanced sieves could not be made and sold without paying a royalty to the inventor, adopted the rotary motion. This is one of the principal reasons why balanced sieves are not so numerous.

The advocates of the rotary motion claimed that there was a scouring action attendant on this motion, and that a recip-

rocating motion was in this point [illegible]. It is hard to see where this virtue [illegible] as at this stage of cleaning the [illegible] simple separation of the wheat [illegible] grades is required. Scouring [illegible] a distinct operation, and [illegible] particular machine.

It is best for the [illegible] to one operation [illegible]

out, good work ought to be done, and the machine is easily adjusted, and not liable to get out of order; but, on the other hand, machines that seem to embody the whole wheat-cleaning arrangement should be regarded with suspicion.

It has been stated before that the sieves have a perforated covering. This covering should always be of *steel*, and not zinc. This is one of those little details that so often escape the notice of millers when ordering machines of this description. The perforated coverings commonly found on the machine will wear away in a few months' time with daily use; *steel* soon pays for itself, and lasts for years.

Under ordinary work the wheat separator has three sieves, the wheat being delivered to the top sieve, the perforations being about ⅛in. diameter, this coarse perforation being sufficient to allow all the large wheat, etc., to pass through to the next sieve. At the same time, all the large rubbish will be delivered over the tail end of the sieve.

The next sieve has a finer perforation, about ⅛in. full diameter, or No. 7. In this case the large wheat is delivered over the tail end of the sieve, and the small wheat, seeds, etc., pass through to the third sieve. This sieve is clothed with No. 9, and is intended to take out small seeds, cockle, etc., and the small wheat being too large to pass through this clothing is in this case delivered over to the tail end of the sieve.

At this point we have three products from one machine neglecting the large refuse: (1) Large wheat, (2) small wheat, (3) broken wheat, barley, cockle, and a variety of small seeds. We shall at present deal only with the two first divisions —viz., large and small wheats.

The above description is simply an outline of what is required at this stage, and it must not be supposed that a perfect separator has been obtained. For instance, the large wheat will contain peas, beans, and barley, all of which will pass over with the large wheat. Again, the small wheat will contain cockle and other seed of the same size as itself, consequently the large and small wheats must be passed over other sieves to remove more impurities. The more perfect the separation obtained at the separating sieves the less work is thrown on to the other machines.

In small roller plants from two up to about ten sacks capacity it is not usual to have two grades of wheat to clean. In these cases the large and small wheats are cleaned together, not because the same results can be obtained by keeping the two grades together, but simply because the miller cannot afford a duplicate set of wheat-cleaning machines, or if he could, he has no floor space available. To thoroughly clean wheat it must be in two grades—viz., large and small, each grade having its own special set of machines. This is a recognised truth in the milling world, but is only carried out fully in flour mills of large capacity.

All wheat-grading machines should be cased in—that is to say, the machine should have movable shutters that can be easily taken down and the machine examined. At the present time this plan is not carried out, and the consequence is that there is more or less dust rising from the machines, filling the air and settling on the walls, etc. Apart from this being a dirty arrangement, there is that terrible risk of fire and explosion. These machines ought to be closed in with quite as much care as if they were high-speed machinery, and not only should the exhaust fan draw away the light seeds and dust from the wheat before it is delivered on to the sieves, but it should also draw away the dust caused by the movement of the machine. It is a well-known fact among millers that no matter how much the wheat has been cleaned, or what elaborate wheat-cleaning machinery it has passed through, it is always possible to get more dust or dirt from the wheat—viz., small particles of the outer coating of the wheat, usually a fine brown flake, but so minute as to resemble dust. This shows the necessity of closing in all wheat-grading sieves and thus confining the dust to the enclosed part of the machine.

The capacity of wheat graders depends principally upon the speed they are driven at, assuming that the sieves are properly clothed with perforated coverings suitable for their work. A sieve area of 1½ to 2 sq. ft. per sack (280lb.) of wheat would be sufficient to do good work, having a speed of 180 revolutions per minute. In a recent experiment with a rotary wheat grader making three separations, the writer was able in the hour to pass eight sacks (280lb.) of wheat through a sieve 6ft. long by 1ft. 6in. wide, which gives an area of 1sq. ft. per sack (280lb.) of wheat. The speed of this vertical shaft was 180 revolutions per minute. The writer prefers allowing a greater area than 1sq. ft. per sack per hour, as it is quite possible for a large number of perforations to be filled up with rubbish, and consequently more or less of the grading surface is rendered non-effective, and the separation will be bad. In order to guard against this danger, milling engineers rushed to the other extreme, and allowed more grading surface than actual circumstances demanded, and thus a lot of valuable floor space was occupied, to the detriment of the other machines.

If from 1½ to 2sq. ft. per sack (280lb.) of wheat be allowed for grading wheat, the machine will then be in proportion to the work it has to perform, and will take up considerably less floor space than some of the clumsy wheat graders now at work.

The large and small wheat passes from the wheat grader, or separating sieves, through an aspirating machine or air sorter. This machine separates all light seeds and refuse that have not the same specific gravity as a sound grain of wheat. The action of this machine is dependent upon (1) gravity, and (2) powerful air currents obtained by means of suction fans drawing their air through this machine. Fig. 20 shows a cross-section of this machine, and indicates the manner in which the air currents are applied to separate the light seeds, dust, etc.

The wheat is delivered into the hopper A, and passes over the feed roll in a thin stream, the amount of discharge being regulated by a slide marked B. This feed roller is of the full length of the machine, and is grooved with from 4 to 6 grooves per inch. As the wheat leaves the feed roller in a thin stream, it is met by an up-current of air of sufficient strength to draw all light seeds and dust from the wheat. This air current is regulated by the valve D. It will be seen that the suction fan E can only draw air from where the wheat is discharged; consequently the air current is stronger in the part marked F F than elsewhere. The moment the seeds and light dust pass the valve D into the space marked H, the pressure is less, and all seeds and dust of a very light nature will follow the reduced air current, and pass through the fan on to the dust-collecting rooms; while, on the other hand, the heavy seeds and dust will fall down into the receiving hopper marked K, as the air current is too weak to carry these through the exhaust fan.

The valves marked L and L^1 are made an air-tight fit, the up air current from the fan keeping the top valve L closed. In the course of five or ten minutes the weight of dust and seeds overbalances the pressure of the fan, and the valve L opens and discharges the weight upon it to the valve L^1. This valve is usually weighted to keep it in its place, so that it is impossible for any air to be drawn through the machine except by the way of the wheat discharge spout.

If the valves L and L^1 are not a proper fit, or are out of order, and air can be drawn up through the dust discharge valves, the action of the up-current in F F is reduced to a minimum, and a proper separation is not effected.

This simple machine is made in almost every shape and form, with an equal number of high-sounding names. In some designs the feed roller is placed at the top of the machine near the valve D; in this case the wheat falls about 3 or 4ft., and is, of course, exposed longer to the upward current of air in the passage marked F F. Some connect the feed hopper to the exhaust fan, etc., etc. In Fig. 20 the working principle of such a machine is clearly shown; once this is mastered, the form the machine is to take, and the other details, are only secondary considerations.

This machine can be made of any length, but it is not advisable to have a feed roller over 5ft. long, as better results are obtained by the use of narrow machines. There is a great difficulty in spreading an even feed over a long feed roller, as the grain has a tendency to back up, and cause a "choke." To overcome this, spiral worms are placed in the feed hopper A to distribute the feed over the feed roller. This feed hopper is also in connection with the exhaust fan, so that any light seeds, etc., lifted or moved by the worm are at once drawn away.

In this case it is evident that for the machine to properly do its work the full length of the feed rollers must have a feed of wheat, or a certain amount of air will pass between the feed roller and slide without doing any work. In place of using large machines, say one with a 5ft. feed roll, two small machines with 2ft. 6in. feed rolls would be more than equal to the capacity of the large machine, and far more easily manipulated.

It is usual to make this machine principally of timber; the feed roller and its bearings, with the feed regulating slide, are made of iron. The parts of the machine which the grain touches should always be lined with sheet iron. No. 16 B. W. G. is the best for this work. If this plan is not followed, these parts soon wear away and cause a lot of trouble. The principal reason why this point is mentioned is that milling engineers and other makers of this machine rarely line them with sheet iron, for reasons that can easily be imagined. Millers find this item under the head of extras, although it is quite as important a feature as the feed roller.

(To be continued.)

On Shipbuilding in Portsmouth Dockyard.

(*Concluded from page* 137.)

"*Royal Arthur*" *and* "*Crescent.*"—The "Royal Arthur" and "Crescent" are two of the nine first-class cruisers provided for under the Naval Defence Act. In nearly all respects these vessels are similar to the "Edgar," of which the steam trials have been made most successfully, the ship realising a maximum speed of nearly 21 knots. Like the "Centurion," these cruisers will be wood-sheathed and coppered. The "Royal Arthur" was laid down in January, 1890, and is to be completed this year. The "Crescent" was begun in October, 1890, and will be completed in the next financial year.

In general arrangement the "Royal Arthur" may be described as belonging to the protective-deck type of cruiser. The hold-spaces containing engines, boilers, magazines, etc., are covered in by a curved steel deck, having a maximum thickness of 5in. on the slopes, and 2½in. on the horizontal or nearly horizontal portion. This deck runs from stem to stern, and is supplemented by coal-bunker protection. Vertical engines are fitted to drive the twin-screws; and in order to secure good working conditions for continuous steaming, the cylinders are allowed to come above the level of the protective deck, and are furnished with special armour protection.

The armament is exceedingly powerful. It includes one 9·2in. 22-ton gun, mounted aft on the upper deck, where it can be fought on either broadside or as a stern-chaser; and 12 6in. quick-firing guns, of which four are carried on the main deck, six on the upper deck, and two on the high forecastle, which stretches back more than 100ft. from the bow. Besides these, there are 17 smaller quick-firing guns, 6-pounders and 3-pounders, mounted on the decks and other stations. All these guns and their crews have protection given them either by steel shields revolving with the guns or by fixed armour.

The "Royal Arthur" and "Crescent" differ from the other first-class cruisers in the possession of the high forecastle with two 6in. guns mounted thereon. In the other vessels there is no forecastle, the freeboard forward is about 7½ft. less, and a single 9·2in. gun forms the bow armament.

The estimated cost of the "Royal Arthur," exclusive of armament and incidental charges, is rather less than £350,000.

"*Fox.*" — Another type of protected cruiser is presented in the "Fox," which is as yet in an early stage of construction. In size, armament, and protection this cruiser is much inferior to the "Royal Arthur." The speed is about the same. The estimated cost, exclusive, as in the "Royal Arthur," of armament and incidental charges, is rather more than £200,000. These vessels are of high freeboard throughout their entire length, and carry all their guns on the upper deck, at a great height above water. These features will add largely to their habitability, fighting efficiency, and power of maintaining speed in rough water. There are eight vessels of this type in hand, all to be wood-sheathed and coppered.

"*Intrepid.*"—The "Intrepid" is a somewhat smaller type of cruiser than the "Fox," costing about 90 per cent. of the latter. In protection the two classes are identical; in armament the "Fox" is somewhat superior. In speed the difference will be small. The most important distinction is that in the "Intrepid" a long poop and forecastle are fitted, with an upper deck or waist between them at a moderate height above water, instead of the flush upper deck of the "Fox." Twenty-one sister ships to the "Intrepid" have been built under the Naval Defence Act, and most of them are now complete. The "Latona," the leading vessel of the class, has been tried in an experimental cruise to the Mediterranean, as well as in the manœuvres of 1891, and has been most favourably reported on.

"*Vulcan.*"—The "Vulcan" is a vessel quite unique in character. Her special mission is to carry eight torpedo boats of the second class, and for this purpose she is fitted with powerful hydraulic cranes capable of lifting boats weighing 20 tons. She is equipped with a workshop containing a large amount of machinery for use in repairing torpedo-boats, torpedos, etc. A very complete laboratory is provided on board, for use in connection with torpedo and mining operations. The ship also carries a full equipment of mines and stores, and is fitted with specimens of torpedo-ejecting apparatus both above and below water. Besides all this special equipment, she carries a fair armament of guns, including eight 4·7in. quick-firers and 12 3-pounders. Her vitals are defended by a strong steel deck, having a maximum thickness of 5in. She is, in fact, a lightly armed protective-deck cruiser of high speed, capable of defending herself against all but the most powerful cruisers or battleships; and, in addition, she is a torpedo-boat carrier, a floating factory, a torpedo-practice ship, and a depôt for mining stores. Her trials at sea have been deferred in consequence of difficulties which arose in connection with leakages of boiler tubes. Experiments are now in progress in other ships, which it is hoped will enable these difficulties to be surmounted. From the steam trials already made it is certain that, if this hope is realised, the estimated maximum speed of 20 knots will be attained with ease. The cost of the "Vulcan" complete with all her special machinery, but excluding guns and incidental charges, is rather less than £340,000.

Reconstruction and Repairs.—The work of this kind now in hand at Portsmouth, which there is an opportunity of inspecting at the present time, may be illustrated by the "Devastation," respecting which particulars have already been given, and also by the "Hercules," the "Sultan," and the "Rupert." The "Hercules" is now approaching completion, having been fitted with vertical triple-expansion engines and high-pressure boilers, while her sails have been removed and rig altered. Her main armament remains unchanged; but quick-firing guns have been added, and many other changes made to increase her fighting efficiency. The "Sultan," which is a very similar ship to the "Hercules," ran aground at Malta, and afterwards foundered; but, having been raised, she was brought to England. Her repairs are to be commenced in the present year, and her refit will probably follow lines similar in many respects to those of the "Hercules." For the "Rupert" turret-ship, built with special reference to her use as a ram, new vertical triple-expansion engines have been made in the dockyard, and in the turrets breech-loading guns are to be substituted for muzzle-loaders. These and similar works of reconstruction are bringing once more into line, with greater fighting powers, ships which have already done good service.

Although this paper has extended to considerable length, it is even now a most incomplete sketch of the work and capabilities of Portsmouth dockyard. It may, however, serve a useful purpose if it facilitates the inspection of the establishment on the occasion of the present meeting of the Institution. In the published proceedings also it may have some permanent interest as a record, however imperfect, of the shipbuilding operations carried out in England's greatest naval arsenal.

Shipbuilding Notes.

It is stated that Messrs. Russell and Co. have contracted to build a steel sailing barque to take the place of the "Auchmountain," blown up at the Tail of the Bank. The new ship is to be 1250 tons, the same as the other.

Messrs. Sir W. G. Armstrong, Mitchell, and Co. launched on the 27th ult., from their Walker yard, a screw steamer for the carriage of petroleum in bulk. The dimensions are:—290ft. long, 37ft. 6in. beam, and 27ft. 6in. deep, and capable of carrying about 3000 tons of oil.

On the 24th ult. the steamer "Pendarvis" left the No. 2 dockyard of Sir Raylton Dixon and Co., Middlesbrough, for her official trial trip, which was in every way most satisfactory. The dimensions are:—Length over all, 311ft.; beam, 40ft.; depth moulded, 22·10½ft.; and she will carry about 4000 tons deadweight. The engines have been fitted by Messrs. Thos. Richardson and Sons, of Hartlepool, the cylinders being 23in., 37½in., and 61½in. diameter by 39in. stroke.

The steamer "Hildawell," recently launched by Messrs. Wm. Gray and Co. Limited, of West Hartlepool, went on her trial trip on the 28th ult. The dimensions are:—300ft. in length, 39ft. in breadth, and 22ft. 10in. in depth, and a deadweight capacity of nearly 4000 tons. The triple-expansion engines are supplied by the builders, and have cylinders 22in., 35in., and 59in. diameter, with a piston stroke of 39in. During a run of four hours, an average speed of 11½ knots was attained.

Great-Eastern Railway Locomotive Works.

On the 27th September a visit was paid by the Society of Engineers to the Great-Eastern Railway Locomotive and Carriage Works at Stratford, E.

The works were opened in the year 1847, and now occupy a total area of 52 acres, of which the shops alone cover 13. The number of hands employed at these works is about 4800. The rolling stock consists of 546 tender engines, 357 tank engines, 3785 carriages, 16,118 wagons, and 925 road vans, which are renewed and kept in repair mainly at these works. The whole of the new stock, averaging 1½ engines, 6 carriages, and 14 wagons per week, is also now built at the Stratford works; 1260 carriages are lighted with compressed oil gas, and all engines and carriages used for passenger trains are fitted with the Westinghouse automatic compressed air brake.

Locomotive Department.—The erecting shop is 348ft. by 142ft. It has four bays, the two centre ones being used for erecting purposes, and 50 engines can be in hand at the same time. Here were some new four-wheel coupled mixed traffic engines in course of erection. It was in this shop that a locomotive of the goods engine type was recently built in 10 working hours, being commenced at 9-0 a.m. on December 10, and turned out finished at 9-15 a.m. on December 11, 1891. There are four 30-ton and one 15-ton overhead travelling cranes, worked by fly-ropes, travelling at a velocity of about 2200ft. per minute; also four 3-ton hand cranes. The main portion of the drilling on the pits is done by "Stow" flexible shafts. There are also portable machines for cutting off tube ends, boring and facing cylinders, facing slide valve faces, dome tops, and tapping stay holes.

The two side bays are used for fitting purposes, boiler mounting, and for heavy machinery, including a frame-slotting machine, radial drills, planing machines, cylinder-boring machines, and a vertical milling machine, all of which are continually at work.

In one corner of this shop there is a 50-ton testing machine, fitted with Wickstead's patent self-recording apparatus, which gives stress diagrams of the tests. Bending, compression, and tensile tests are here made of boiler and frame plates, etc., and records kept.

Above the south bay is a floor containing the pattern shop, the chemical laboratory, and the works manager's drawing office, in the latter of which is a model motion for experimentally setting out and determining the motion of different classes of engines. In the laboratory tests are made for determining the constituents of iron, steel, and other materials, the calorific value of coal and oil, the properties of water, etc., etc. Above the north bay is a shop in which Westinghouse brake work is fitted up and repaired, and there are also brass finishers, etc., working here.

In the machine shop, which is 144ft. by 138ft., there are 189 machines, comprising lathes, planing, slotting, shaping, drilling, and milling machines, the latter being a special feature. Twist drills are mainly used throughout the establishment, and were here seen in process of manufacture.

In the iron foundry there are three cupolas, two of about three tons capacity each, and one of seven tons. There are two overhead travelling cranes, one 15-ton hand gear, and one 10-ton, driven by square shafting running the full length of the shop. About 40 tons of castings are turned out per week.

The brass foundry and coppersmith's shop adjoin the iron foundry.

In the boiler shop there are six overhead travelling cranes driven by fly-ropes. The greater portion of the riveting is done by means of two fixed and four portable hydraulic riveters, worked by special pumps and accumulators, two of the portable riveters being specially designed for foundation and firehole rings. A large punching press, for engine frame plates 1¼in. thick, was seen at work, also horizontal and vertical plate-bending rolls.

In the flanging shop there are two hydraulic presses for flanging and stamping plates, worked at a pressure of about 1600lb. per square inch, giving on the 20in. ram of the large press a total pressure of about 220 tons. Boiler, firebox, and other plates connected with engines and tender work are flanged here. The plates are lifted by a specially constructed crane, and are heated in a gas furnace, the gas being supplied from Wilson's patent gas producers, of which there are four outside the shop, two being in use at a time. Six other furnaces are also supplied with gas from these producers.

In the steam hammer shop stamping by means of blocks and dies is carried on to a large extent. There are four gas furnaces, which are supplied with gas from the Wilson's producers; an extra heat per day is got out of these furnaces as compared with those heated with coal.

In the wheel shop there are two powerful hydraulic presses for pressing the wheels on and off the axles; these are worked by pumps, which give a pressure on the ram of 200 tons. The various processes of turning and slotting the wheels, tyres, axles, and crank axles were seen in action, including six lathes with 9ft. faceplates.

In the carriage department there were in course of construction four first-class saloons and 30 third-class suburban carriages, and in the saw mills some of the best and most improved machinery for cutting up, planing, moulding, and preparing the wood ready for the use of the carriage and van builders. There are also machine, fitting, and smith shops in this department.

The wagon department also has extensive saw mills, and in the wagon shop there were about thirty 10 ton coal wagons and thirteen cattle boxes in course of construction. Near here is a shop for the manufacture and repairs of carriage and wagon wheels.

In the boiler house attached to the wagon department saw mills are three stationary boilers of the locomotive type, fitted for burning liquid fuel in combination with solid incandescent fuel.

Close by is an oil gas works in connection with train lighting. After generation, the gas is washed on its way to the gas holder, and then compressed into cylindrical holders to eleven atmospheres. There are five of these holders in use, each capable of holding 12,500 cub. ft. of gas. The receivers on the carriages are charged to a pressure of seven atmospheres. The carriages fitted for burning this gas are most of them charged at Stratford, but travelling gas holders are sent to Enfield, Palace Gates, Wood-street, Woolwich, Chadwell Heath, Loughton, and Harwich to charge carriages sleeping at these places.

The average amount of gas made in winter is about 160,000 cub. ft. per week at atmospheric pressure, and in summer about 80,000 cub. ft. per week, or about 3,000,000 cub. ft. in six months. The boiler which supplies steam for working the compressing engines burns as fuel the tar which is a by-product from the manufacture of the gas.

Liquid fuel is also used in the boiler shop for two of the rivet furnaces; the rivets are heated quicker than with coal furnaces, and are not scaled to such an extent. The furnaces are also heated to the required temperature in much less time, and the heat is more under control. The injectors are worked by air at a pressure of 25lb. per sq. in., from a reservoir used during the winter for the Lucigen lights.

The same system is applied to locomotives in combination with solid incandescent fuel, and one of these engines, No. 760, was seen. There are two injectors for spraying the liquid fuel, which in this particular engine are so arranged that the steam jets provide the necessary vacuum for working the automatic vacuum brake.

The Electric Transmission of Power.

(*Continued from page* 132.)

(3.) *The Line.*—Having converted the power into the form of electrical energy, we must now transport it to the place where it is to be used. The line wires do this. For lighting, the lamp is the place where the energy is to be utilised, and the wire leading from the dynamo to the lamp may be thoroughly insulated and placed overhead, underground, or anywhere, so far as fulfilling its duty in this respect is concerned. In railway work, we want the current at variable points over many miles of streets, and this can only be obtained by the use of bare conductors and brushing, sliding, or rolling contacts. It is this essential difference between railway and lighting work that prevents us from placing the railway wire underground, as we do the lighting wire. The railway wire must be bare in order that we may obtain electrical contact every fraction of inch from one end to the other. To place this bare wire in a hole in the ground, and keep it securely insulated from the ground, to keep the width of the slot down to safe dimensions, and yet work the conducting plow, which must be absolutely insulated from both sides of the slot, has been found to be no easy task. Every practical trial in this country has failed.

(4.) *The Motor.*—The motor is simply the dynamo reversed in its operation, and the various forms are those best suited to the varying conditions of use.

Several different systems have been successfully used for long-distance transmission, but the alternating has proved most successful. The difficulty of handling a potential of over 2000 volts direct current has hindered progress in this direction. The sparking between the segments of the commutators in these dynamos, and the difficulty of insulating for such high pressure, have been sources of trouble. In the alternating, where a low potential can be developed in the dynamo, and by the use of step-up transformers, raised to any desired height, this difficulty is avoided.

The following are some of the actual examples of electrical transmission which we find abroad and at home.

Many of the large waterfalls of Europe, notably of Switzerland, are now being utilised, and the neighbouring cities and towns lighted by electricity, transmitted distances ranging up to 112 miles.

Probably the most notable plant ever constructed is that of the Frankfort Exhibition, where over 300H.P. was transmitted 112 miles by means of three slender bare wires No. 4 B and S gauge.

Lauffen, where the generating station was located, is situated on the Necker, a branch of the Rhine, and the enormous water-power was utilised to generate 300H.P. of electrical energy at a tension of from 16,000 to 30,000 volts.

At Lauffen, step-up transformers were used to increase the potential from the 50 volts of the dynamos to these very high pressures used, and at the other end of the line—namely, in the grounds of the electrical exhibit—step-down transformers reconverted the pressure to a point where it could be utilised for both light and power uses.

An immense bank of lamps, wired up in series, gave evidence of the high voltage of the line. In only one case did the insulation break down, and that was at a strain of 30,000 volts.

An interesting feature of the installation was the supplying of an artificial cascade, 30ft. high, with water pumped by means of the electrical current, thus completing the cycle of changes. The experiment was undertaken more as a matter of scientific investigation than an attempt at commercial success. An efficiency of 74 per cent., however, was obtained.

The cost of the installation per effective horse-power based on the assumption of 300H.P. delivered at Frankfort was a little over 300dols., of which the cost of the line involved 210dols.

During the progress of the exhibition the plant was run at a potential of 16,000 volts. At the close, however, experiments were made at a very much higher pressure. The insulators were made in three sections. The porcelain top was flat, with a deep groove to hold the wire, and underneath a saucer-shaped receptacle. Beneath this was another receptacle of larger breadth and depth, and under this still another. All were filled with oil. On final experiments the pressure was increased to 20,000 and finally to 30,000 volts. Though none of the insulators gave way, a plate of glass was easily punctured. It is believed that these insulators, somewhat modified in form, can readily be made to stand a pressure of 50,000 volts.

During the experiments regular readings were taken at both ends of the line, and voltmeter readings were taken between one conductor and the neutral point in each of the three circuits, which averaged 54 volts, the current readings being 500, 490, and 500 ampères, respectively in the primary circuits. The mean electric power delivered to the line was 80,500 watts. At the same time the Frankfort end of the line delivered current for 1060 incandescent lamps of 16C.P., which absorbed about 58,000 watts. These figures give the 74 per cent. efficiency which it is claimed is low owing to the lag. Wet weather was not found to appreciably affect the working of the line. The losses due to condenser action of the conductors were also found to be very small.

A description of the Lauffen-Frankfort transmission plant is not complete without brief reference to the permanent transmission of power from this point—to wit, Lauffen to Heilbronn, a distance of 7½ miles. The plant is owned by the Lauffen Portland Cement Company, and the power, besides running their work, also supplies the city of Heilbronn with light. The power plant is of 1500H.P. capacity, of which 600H.P. is used for the cement works, leaving 900H.P. for the supply of light and power. The alternating-current system is used on account of the great distance the current is transmitted. A 300H.P. rotary-current dynamo with a capacity of 4000 ampères at 50 volts is used. This current is transformed to 5000 volts. The transmission is by three sets of bare wires, 0·24in. in diameter carried on overhead poles with oil insulators. An ingenious device for protection against lightning is the placing of an ordinary barb wire above the wires on the pole, and connecting with earth at frequent intervals. At the outskirts of the town of Heilbronn the current passes through a large transformer similar in type to that at the Lauffen end, which transforms the current down from 5000 to 1500 volts. From here it is conveyed by concentric cables underground. At more central points other transformers are located which reduce the potential down to its final pressure of 100 volts, at which it is supplied to customers.

The total loss in 7½ miles of leads and in the double transformation is said to be only 20 per cent., 160,000 watts of the 200,000 generated at Lauffen being available to customers. This is sufficient for 3200 incandescent lamps of 16C.P.

(*To be continued.*)

Trade Notes.

The Rhenish Steel Works have declared a dividend of 10 per cent. for the past year.

The directors of the Blake and Knowles Steam Pump Works announce a dividend of 15 per cent.

The directors of the London and Glasgow Engineering and Iron Shipbuilding Company recommend a dividend of 5 per cent.

The Mulatiere' Works, Lyons, have completed a large order for weighing machines for the Eastern Railway Company of France.

Messrs. Deed, Londheimer and Co., of Frankfort, have contracted to supply 70 tons of tin to the Baden State Railways, at Carlsruhe.

The Bedson Wire Company have purchased a site in the Marsh district, Middlesbrough, where they intend erecting new works.

It is stated that Messrs. Norton Brothers, of Chicago, have constructed an automatic tinning machine for the manufacture of tin plates.

Mr. T. Mudd, of the Central Marine Engine Works, West Hartlepool, has constructed a new type of evaporator for use on vessels.

The Austrian Northern Railway Company have given an order for 20 passenger carriages to Messrs. Ringhoffer, of Smichow, Austria.

Messrs. Mather and Platt, Salford, have recently constructed a heavy electric locomotive for use at some large ironworks in Sweden.

Messrs. Mayer and Coulson, Glasgow, have just completed an installation of electric light at Ardrossan Harbour. There are 17 arc lamps, each of 3000C.P.

Messrs Davey, Paxman and Co., engineers, Colchester, are to supply the engines required by the Great Eastern Railway Company for the electric-lighting plant at their London railway stations.

The Palmer Shipbuilding and Iron Company, Jarrow, have closed their melting furnaces, owing to the scarcity of orders for steel plates. The mills, however, continue in operation as usual.

Messrs. Harpers Limited, of Aberdeen, have placed an order for the electric lighting of their new workshops with the General Electric Power and Traction Company Limited, of Kentish Town.

The Mint, Birmingham, formerly belonging to Messrs. Ralph Heaton and Sons, has completed its arrangements for hot-rolling, and the mills, which will supply all kinds of copper and brass sheets, rods, etc., have been set in operation.

Our very natural anxiety that our readers should enjoy "Good Health" is sufficient excuse for drawing their attention to the new weekly paper bearing that felicitous title. It is one of the most useful pennyworths in existence, and bids fair to become indispensable to every household.

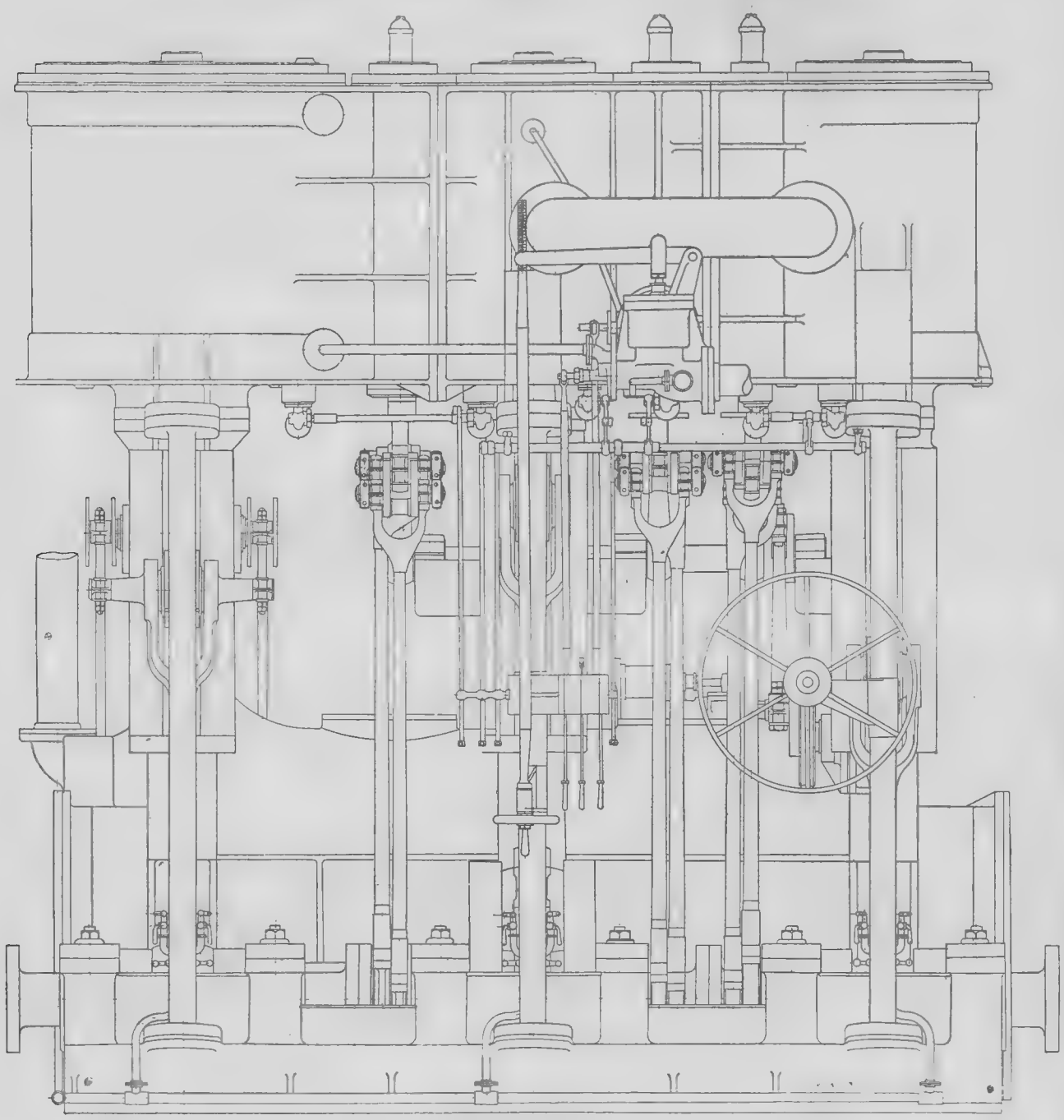
It is proposed to form the Glasgow Chain and Anchor Company, with headquarters in Glasgow, which will represent an industry which has not recently flourished on the banks of the Clyde. The idea is to establish the works at Coatbridge, as being the most suitable centre alike for material, labour, and ready transit at moderate cost.

Wheel cutter in metal only. Every description of gearing. R. Chidlaw, 43, City-road, Manchester.

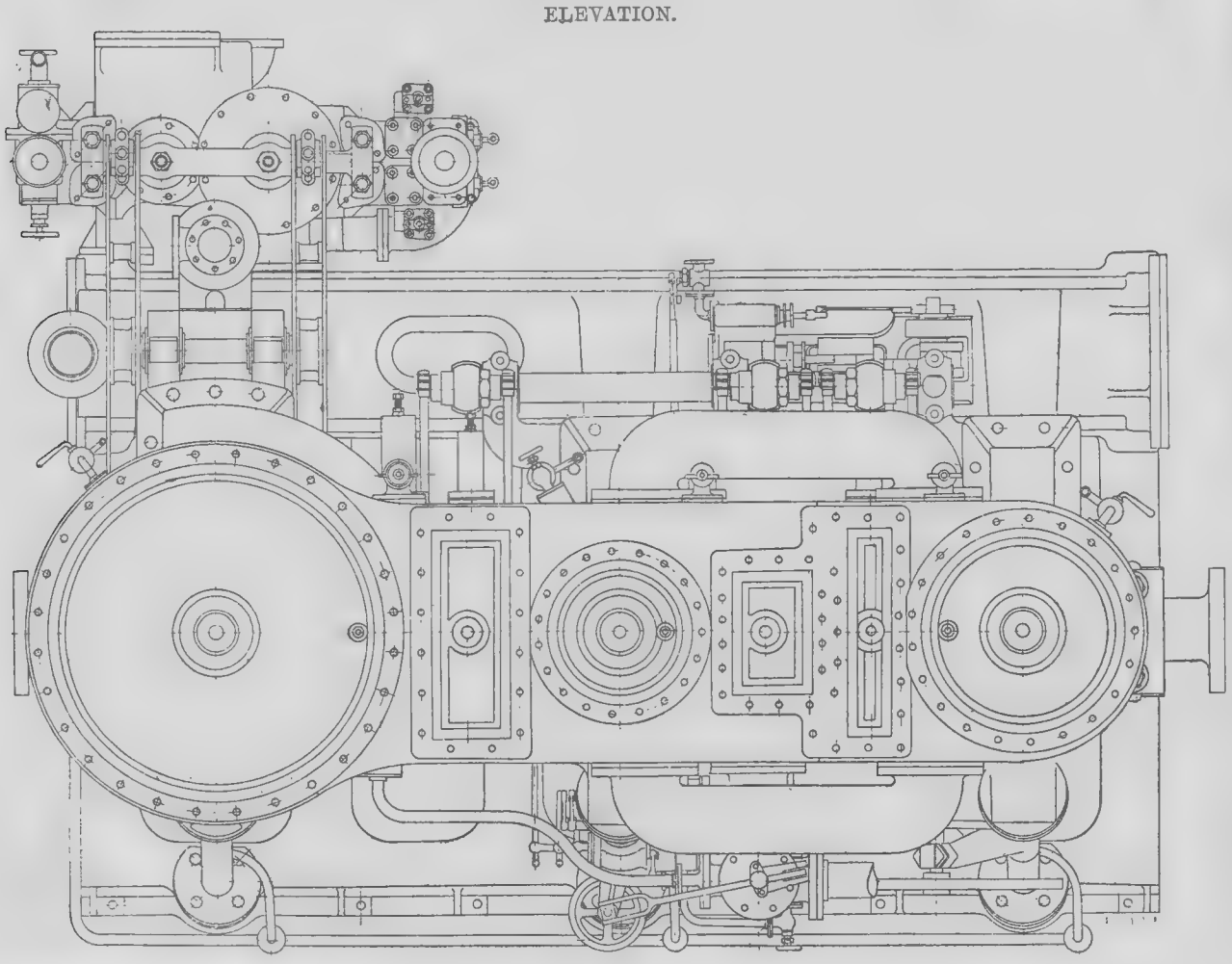
Having regard to the enormous circulation of The Mechanical World, the Editor suggests that it is by far the best medium for the insertion of every kind of "Wanted" advertisement, and the price is only one halfpenny per word. The Editor will be glad if Mechanical World readers will kindly bear this in mind as occasion arises.

TRIPLE-EXPANSION ENGINES OF THE S.S. "HEIGHINGTON."

THE CENTRAL MARINE ENGINE WORKS, WEST HARTLEPOOL.



ELEVATION.



PLAN.

Triple-expansion Engines of the s.s. "Heighington."

HEREWITH we have pleasure in giving illustrations of the triple-expansion engines of the "Heighington," a steamer belonging to the Hudson Shipping Company Limited, of West Hartlepool. The vessel was built by Messrs. William Gray and Co., of West Hartlepool, and engined by the Central Marine Engine Company.

The engines, which were designed by Mr. Thomas Mudd, have cylinders 23, 36½, and 62in. diameter, with a stroke of 36in. The high-pressure engine is placed in the middle, in which position it is saved from the evil effects of radiation, to the great benefit of the economy as a whole. The engines are provided with three wrought-iron columns at the front, and the details of the design are such as to leave all the working parts very easy of access to the engineers. The method of building crank-shafts at the Central Marine Engine Works, and of preparing the bearings to receive them, is such as to result in every part of the bearing surface taking its due share in the work from the outset, and after as much as four years of work these bearings are found, in engines so manufactured, to show scarcely any appreciable wear during the whole of that period. The pistons are fitted with a special type of piston packing which experience has shown to give exceedingly good results both as regards steam tightness and durability. Slide valves are adopted throughout these engines, and they have been found to give more economical results than piston valves. The difficulty sometimes experienced with slides has been entirely overcome by the builders of these engines, and they are in a position to state that in 120 engines sent to sea with slides in all the three cylinders, there is not one that has required a renewal up to the present, or that is in any way promising to need such renewal.

As illustrating the economical character of the propelling machinery illustrated, we may state that the "Heighington" left the Tyne on the 1st of July last, fully loaded, with a total displacement of 6100 tons, and carrying a deadweight of cargo and bunkers of about 4300 tons. The vessel arrived at Madras on the 6th of August, having run 7512 knots in 830 hours, giving an average of rather over nine knots per hour for the whole voyage on a coal consumption of 14·3 tons per day for all purposes, or about 13·75 tons per day for propulsion only. Such results as these, obtained in every-day working, are in every way highly creditable to both shipbuilders and engineers.

High-speed Navigation.*

THE author examines: 1st, the various types of fast passenger vessels; 2nd, the cost of high speed under present conditions; 3rd, the prospect of the more or less immediate substitution of some new type of propelling machinery for that at present in use.

Full particulars are given of the following vessels:—"Touraine," "Normannia," "Teutonic," "City of Paris," "Seine," and "Spree," with an analysis of their best passages. The peculiarities of the construction of the different types, their watertight subdivision, etc., are described, and the dimensions and weight of engines and boilers, the number of engineers and stokers, and other useful details, are given.

Under the heading of "The Cost of High Speed," the variation of resistance with speed, and the effect of dimensions, form, and displacement upon speed are dealt with, and formulæ for the determination of I.H.P. for given speeds are discussed, and the realised results obtained with several vessels are compared with them. The last division deals with probable future developments, such as the employment of a metal stronger or lighter than steel—as, for example, nickel-steel or aluminium alloys,—improved methods of ship construction, the introduction of water-tube boilers, increase of steam pressures, the multiplication of screws, and the like. Consideration is given to the proposals to employ the vapour of volatile liquids in the engines, and liquid and gaseous fuels in the furnaces, and gas and electric motors and hydraulic propellers are not neglected.

A TRAMWAY LOCOMOTIVE worked by a gas motor is being tried in Dresden. The engine carries six boxes of compressed gas, which suffice to feed the engine for a distance of 15 kilometres. The car weighs 70cwt., or about 4cwt. more than an ordinary steam car, and it seats 25 persons. In other respects it is like an ordinary car.

* Inst. C.E.: Foreign Abstracts.

A New Surface Gauge.

THE accompanying illustration shows a surface gauge which, as will be seen, possesses some novel features. The stem is graduated, these graduations being read by the thin lower edge of the sliding head which carries the stud upon which the scriber or needle is fixed. This sliding head is in two principal parts, the lower portion, carrying the needle, being a neat sliding fit upon the stem, prevented from turning thereon by the spring pin shown in the sectional view, which engages with a V-groove formed in the stem. The upper portion of the head is also prevented from turning upon the stem by similar means, its upper end being split and made conical, as shown, so that it is clamped to the stem by the knurled nut shown at the top of the head.

To the lower part of this portion of the head is threaded the adjusting nut, the lower part of which is enlarged to fit tightly over a ring of steel which is sprung into a groove turned in the lower portion of the head. Thus a very nice and neat adjustment is secured for the needle.

The scriber shown in Fig. 1, from the "American Machinist," has a tubular shank, which fits snugly over the stud in the sliding head, and its marking point is just 1in. from the centre line of this stud. As the initial graduation on the stem is 1in. from the bottom surface of the gauge,

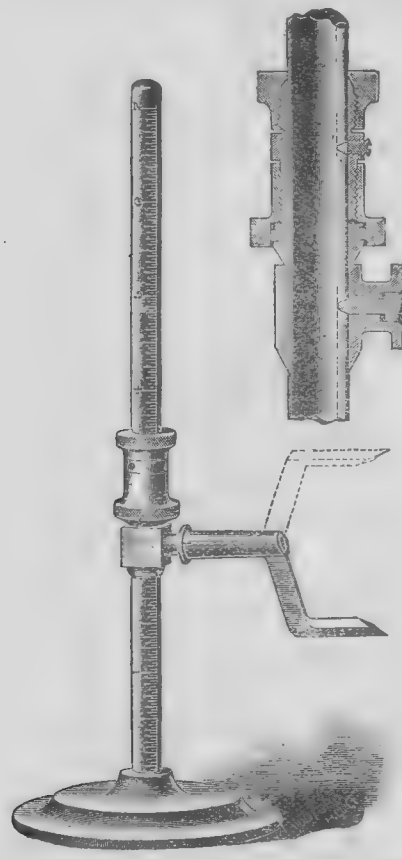


FIG. 1. NEW SURFACE GAUGE.

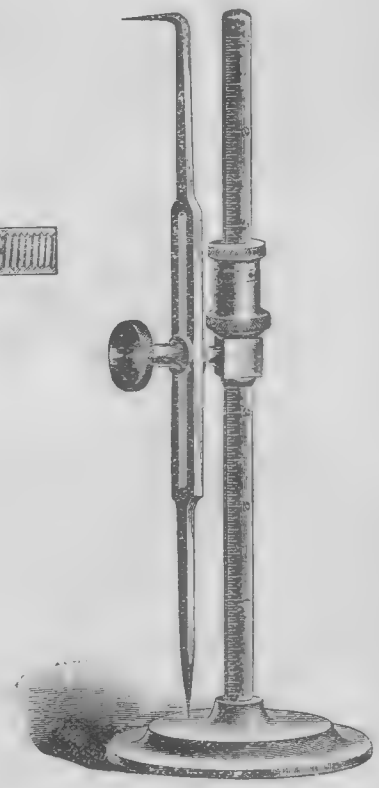


FIG. 2.

the scribing point comes even with this surface when set to zero and in the position shown, while it is just 2in. higher when turned upon the stud to the position shown by the dotted lines, suitable marks indicating when the proper positions are secured. The lower edge of the scriber being straight and parallel to the centre line of the stud, which is at right angles to the stem, the end can be ground off at the angle shown, to sharpen it as it becomes dull, without altering its height.

Fig. 2 shows the gauge with the ordinary form of needle on it, for which the stud is, of course, readily adapted by fitting a screw into the thread at the outer end and providing suitable clamping collars and washers.

An Automatic Regulator for the Consumption of Electricity.*

THE author states that in France the system of sale of electricity by meter has not found favour in all cases; and that there are circumstances in which the supply company undertake to supply the light by contract for the whole number of lamps used, or for a certain less number than the maximum installed. In the latter case, it is obvious that, unless some means be taken to check the consumer, he will be able to defraud the company by using a greater number of lamps than he has stipulated for. Two methods have been employed with the object of preventing such frauds. The one consisted in placing a fusible cut-out in the customer's main, calculated to fuse when the current in use exceeded that agreed upon; the other consisted in so grouping the lamps on the premises of the customer that he could only switch on a given number at one time. Both these methods were found very unsatisfactory; the former because any slight variation in the potential on the supply mains might cause the fuse to melt, and also the possibility of burning a few more lamps than the number stipulated, as the fuses could not be put in so as to be absolutely accurate. The result was that larger fuses had to be employed, and therefore more or less loss accrued to the supply company. The latter method, that of grouping the lamps, was found unsatisfactory because a customer was not at liberty to use which lamps he pleased; and, on the other hand, the switches adopted could be readily tampered with, and a piece of wire properly fixed would enable the customer to burn many more lamps than were agreed upon. A special controlling apparatus was therefore invented by Mr. Maxime Laille, which appears to give satisfactory results in practice. It is so designed that when the stated number of lamps is exceeded, the whole current is either switched off altogether, or all the lamps only burn at a dull red. When the extra lamps are cut out of the circuit, the apparatus automatically allows the full current again to flow.

The apparatus is formed as follows:—An electro-magnet, an oscillating armature, and two mercury contacts form the principal parts. The core of the magnet consists of a bar of soft iron, bent into the form of a closed rectangle. About half the length of the longest side is then cut out, and forms the armature, which swings freely upon a pivot above its own centre of gravity. A tumbler is so arranged that as soon as the armature tilts to one side, it is immediately carried down until one or other contact attached to each end falls into a mercury cup. The current may be supposed to enter the house at +; it flows to the right hand mercury cup, through the armature, round the electro-magnet, and so to the lamps, which are fed in the usual way, and the current leaves at −.

In case, however, the number of lamps which should be lighted is exceeded, the current flowing round the electro-magnet increases sufficiently to cause the armature to tilt and make connection with the left mercury cup. The current from + now flows, first, through a resistance, then round the magnet, through the armature, left cup, again round the magnet, and so to the − pole. The whole of this circuit is a shunt. Some current will, in most cases, still flow to the lamps, but will only keep them at a dull red. If now some of the lamps be switched off, the position of the armature will be reversed, and the normal conditions will be resumed.

The author states that upon a circuit of 110 volts, with a stipulated number of 60 lamps to be used as a maximum, the apparatus will switch off the current when two extra lamps have been lighted, making, in all, 62. He states that the smallest size made is for two lamps of 10 candle-power, and the largest for 60 lamps of 10 candle-power.

* Inst. C.E.: Foreign Abstracts.

Engine and Helm Control.†

THE present means of communicating directions from the captain or the officers stationed on a steamer's bridge to the engineer or machinist on watch in the engine room, or to the quartermaster at the wheel, are either mechanical or electrical. The mechanical devices are, as a general thing, cumbrous in construction, difficult to operate, and quite easily put out of order. The electrical devices are almost always complicated, and in addition are very expensive. There is, and has been for years past, urgent need for a simple apparatus by means of which the person directing the movements of a vessel may not only communicate his orders instantly, but may know with certainty that they are understood and are being executed. This is of the greatest importance aboard warships, where the outcome of a conflict in favour of one side or the other may be dependent upon the rapidity and facility with which the opposing vessels are handled.

It is a serious objection to the existing modes of inter-communication that they do not enable an order to be transmitted with sufficient accuracy. Thus it is quite possible to send a signal to put the helm, for example, to "port" or to "hard a-port," and to instruct the engineer to "back" or "go ahead" fast or slow, or to stop. But there is no reason why much more specific instructions should not be sent, by means of which the vessel may be more accurately controlled. This point receives particular emphasis when several vessels are cruising together or indulging in tactical manœuvres. In this case almost continuous engine speed-changes are required to enable the vessels to maintain proper distance. Furthermore, in action, with casualties constantly occurring, it is exceedingly important for the commanding officer to know that his orders have been clearly understood and implicitly obeyed. The more automatically this intelligence can be conveyed the greater the immunity from error and the more rapidity possible.

† Proceedings of the U.S. Naval Institute.

After a great deal of practical experience afloat and much study of the subject, Lieut. Bradley A. Fiske, United States Navy, has recently developed a signalling system of great ingenuity, which brings the guns of the battery, the helm and the engine-room much more completely under the control of a single person than has ever hitherto been accomplished. The system includes numerous arrangements of apparatus, which are well represented in the accompanying diagrams. The system as here given is for use for controlling the engine or the helm. In a somewhat modified form it could be readily adapted for transmitting from the observer to the gun-captain the distance the target is from the firing position, as determined by the clever range-finders that have been adopted by our navy department and that of several of the foreign powers.

Referring first to Fig. 1. Here are shown two arcs of conducting material, over which move two pivoted arms B and H. The arcs are graduated on each side of their central points to indicate the revolu-

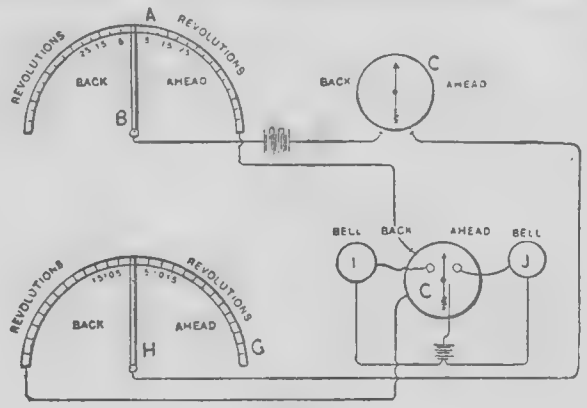


FIG. 1

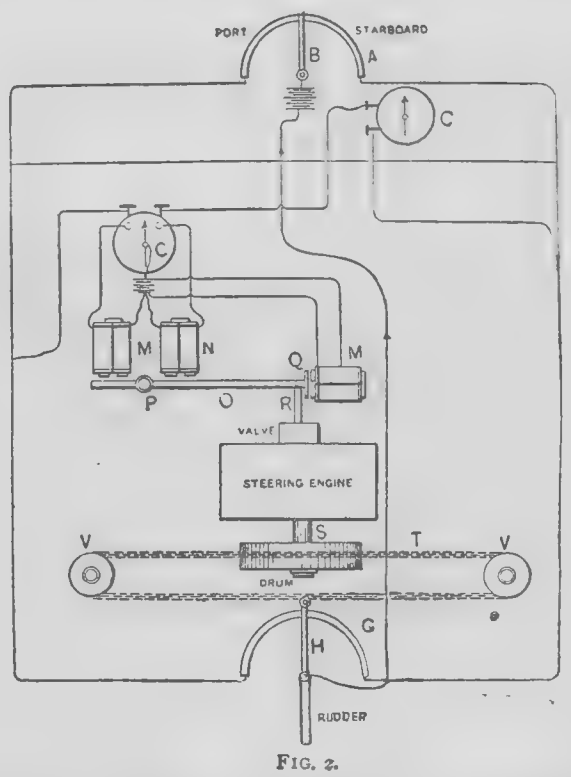


FIG. 2.

ENGINE AND HELM CONTROL.

tions made by the propeller of the vessel. The arcs and arms are connected in series with two indicating instruments—one arc and one indicating instrument being located, for example, on the vessel's bridge or in the conning tower, the other one in the engine room. In connection with the needle of the instrument of the engine-room indicator are arranged two local circuits, each containing a bell or other suitable alarm, which circuits are respectively closed as the needle moves to its stops in one direction or the other.

If the apparatus be arranged as indicated in the diagram, the arms being at the middle points of their arcs, and it be desired to send a signal to the engineer to "go ahead," the arm B should be moved to the right. By this means the resistance in the circuit is diminished, causing a deflection of the needles of the two indicators in the same direction. The engineer then not only sees the needle of his indicator move, but also hears a bell sound. And as this bell may be of different tone, for example, from the one included in the other local circuit, he has both visible and audible notice of the order. Meanwhile, the person sending the order notes by the deflection of his indicating instrument that it has been transmitted.

Now suppose, further, that it be desired to have the vessel go ahead at slow speed. The speed of the vessel for a given number of revolutions being approximately known, the person sending the signal moves the arm B, for example, to the mark 15 on the arc A. The results already referred to will then occur. The engine room bell will, however, continue ringing, and the needles of the indexes will remain deflected until the engineer re-establishes the balance of the circuit. This he does by moving the arm H on his arc G to the right to the number 15. He will thus obviously have thrown into the circuit a resistance equal in amount to that by which the total resistance in the circuit had been diminished, thus restoring the normal condition. The needles of the indexes will then return to their normal position, the alarm will cease sounding, and the person sending the signals will be apprised that his order has been exactly complied with. By this device an exceedingly accurate and certain mode of regulating the speed of the ship is at all times available, and confusion resulting from hastily given and but partially understood orders is done away with.

In order to directly control the helm so that the rudder may be adjusted at any exact and desired angle, and also to cause knowledge that the order transmitted has been correctly executed, the apparatus shown in Fig. 2 was devised. It is an automatic means of controlling the helm directly and without the intervention of anyone but the person sending the signal.

In this case, as in the one already described, there are two arcs, A and G, over which move pivoted arms H and B. These arcs are connected in Wheatstone bridge circuit with a battery and with two indicating instruments, one of which is located at the sending station and the other one near the steering engine which controls the helm. No particular form of steering engine is required; any one of the standard patterns already in use will do. For example, take one that operates a drum, S, around which pass chains that are shackled to the tiller H: when the engine turns in one direction the tiller moves one way, and when it turns in the opposite direction the tiller moves the other way. The arm H on the arc G may be the tiller itself, or an arm actuated by the tiller.

The two local circuits, which are closed by the movement of the needle of the indicator C in one direction or the other, include electro-magnets, M and N, which operate a pivoted armature that in its turn moves the reversing valve of the engine. The magnet M is connected in circuit to the battery which controls the two local circuits, and serves to centre the valve when the parts are in normal position, as indicated in the diagrams. Now, when it is desired to put the helm in one direction or the other, the person stationed at the arc A simply moves the arm B in the direction in which it is desired to adjust the helm, and also to the desired extent. This immediately disturbs the balance in the circuit, and the fact, as before explained, is shown on the indicator C^1 near him, while the needle on the distant indicator closes one of the local circuits, energises one of the electro-magnets M or N, which in turn, attracting the pivoted armature O, moves the valve of the steering engine so as to cause it to move the tiller, and hence the rudder, in the desired direction. As soon as the rudder or the tiller H moves over its arc to an extent sufficient to re-establish the balance in the circuit, the parts return to their normal position, when the electro-magnet centres the armature and stops the engine. The operation, obviously, is thus entirely automatic, and the ship is steered merely by the movement of the arm B.

Liverpool Overhead Railway.*

THE question of improved and more rapid means of transit for passengers is occupying attention in many of the great cities at the present time. With the extension of areas covered the question becomes increasingly pressing. In London it has been under consideration for many years, and during the last session a joint committee of the two Houses of Parliament reported favourably upon a number of proposed underground electric railways of the type of the City and South London Railway, completed and opened for traffic in 1890. In Paris, Berlin, and Vienna similar railways have been promoted, and are under discussion; while in New York, a city long since provided with elevated railways and tramways along most of the main thoroughfares, a Rapid Transit Commission has lately reported in favour of an extensive system of underground electric railways, and in other American cities, notwithstanding the rapid development of electrically-worked tramways, additional facilities in the shape of over and underground lines are being considered. This question, then, is an important one for engineers and the iron industries. All the proposed underground lines are, since the construction of the City and South London Railway, proposed to be made of iron, and that material must necessarily enter largely into the construction of any overhead railway.

The particular railway under discussion is composed almost entirely of wrought iron. The line, now approaching completion, traverses the whole length of the famous Liverpool docks, a distance of about six miles. The extensions north and south go beyond the docks and away from the river in order to give better access between the residential neighbourhood reached by them, the docks and the heart of the city. With the exception of a short length where the line passes under the Lancashire and Yorkshire railway coal sidings, the railway is, as its name indicates, overhead, and for the most part just over the lines of the original dock railway, which is upon the surface. The latter railway serves for the distribution of goods by horse traction, and has been used also by passenger omnibuses, with specially constructed wheels to enable them to leave the track when necessary. They will leave the rails altogether upon the completion of the overhead railway, which will afford a means of transit at least three times as rapid, when the dock railway will be available exclusively for goods.

The overhead railway consists generally of plate-iron girders supported upon channel-iron columns, and carrying an iron flooring, upon which the permanent way is laid direct, without the usual intervening ballast. The normal spans are 50ft., but there are some of 100ft., with bowstring girders, and others of special construction for opening and affording a passage to the docks for exceptionally bulky goods, such as marine boilers, etc.; thus there is a tilting bridge near the Sandown Dock, and a swing bridge of novel construction, and worked hydraulically, crossing the entrance to the Stanley Dock. This is the only dock entrance crossed by the railway, the other docks being on the river side of it. The columns are grouted into cast-iron sockets, bedded in and bolted to masses of concrete, forming the foundation. With the exception of some half-dozen spans, the line has been constructed without the use of scaffolding, and with very little interference with the traffic, either of the docks or of the streets. This important end was attained by adopting a construction which admitted of each span and its flooring being put together at one end, and transported as a whole over the already completed portion of the railway. A depôt was established at the north end of the railway, where the flooring was constructed and riveted together and to the main girders. The whole span was then raised by jacks, a steam bogey with wheels running upon the two rails nearest the main girders (and thus having a gauge of 16ft.) was run under the span, which, being lowered upon the trolley, was carried by it at such a level as to clear the main girders to the southern end of the structure. Arrived at this point, the span was slung upon a movable gantry, and by it deposited upon the columns prepared to receive it. In this manner span after span was added, as many as ten being placed in a week, representing a length of 500ft. of railway.

The decking is of arched plates, finishing to 2ft. 6in. wide and 15in. deep, made water-tight by asphalte placed in the V-channel between the arches; this form of flooring (known as Hobson's arch-plate system), first used on this railway, is being extensively used elsewhere. It is for its weight of great strength and stiffness, and is readily made water-tight. The flooring is made of ordinary iron plates and tees. The plates are 46in. wide by $\frac{7}{16}$in. thick, and vary in length from 22 to 27ft. The tees are $4\frac{1}{2}$ by $3\frac{1}{2}$in. by $\frac{7}{16}$in. in section, and are of lengths corresponding to the plates. In order to ascertain the exact strength of the floor, some actual sections were tested to destruction, and the deflections at each increase of load were carefully tabulated, with the following results:—

Test (*a*) Three sections of floor measuring 7ft. 6in. in width.
(*b*) Span, 22ft., ends resting upon supports.
(*c*) Load distributed over four points corresponding with the positions of the rails.

Test Load.	Deflection at Centre.
30 tons	Nil.
35 ,,	$\frac{1}{16}$in.
40 ,,	$\frac{3}{16}$in.
50 ,,	$\frac{5}{16}$in.
60 ,,	$\frac{7}{16}$in.
70 ,,	$\frac{9}{16}$in.
80 ,,	$\frac{11}{16}$in.
90 ,,	$\frac{13}{16}$in.
100 ,,	$\frac{15}{16}$in.
110 ,,	2in. (limit).

The floor plates ultimately collapsed by the total rupture of the T-irons at 163 tons, and with a deflection of 10in. It is hoped that members may be able to see the actual construction of the decking at the north end. A short description may, therefore, be of interest. The flat plates are delivered sheared to exact length and width. Six of them at a time are heated in a long oven (to a cherry-red heat), whence they are separately hauled out endways into a hydraulic press, which bends them to the required shape. After cooling upon a grid or frame, where they are tightly held to prevent change of form, they are taken to a multiple drilling machine, which drills the requisite rivet holes (about 200) in two operations and in 15 minutes. After the end angle irons, for attachment to the main girders, are added, the decking is completed by riveting mechanically the covered plates to the T-irons forming the lower member. These combined operations are performed at the rate of 40 to 45 plates per day.

There are to be 15 stations. They are built upon iron girders and columns, the platforms being about 115ft. in length by 12ft. wide, and are 3ft. above rail level. Access to the platforms is gained from the street level by four staircases at the more important stations, and on each platform a waiting shed is provided, with pay offices and turnstiles. An extensive carriage shed is erected near the Hornby Docks, with five lines of way running through at the same rail level as the main structure of the railway; and underneath, on the ground floor, is the repairing shop, to be equipped with the necessary tools. The railway is to be worked by electricity, generated at a station for which twelve of the arches forming the viaduct which carries the coal sidings of the Lancashire and Yorkshire Railway have been appropriated, near the Bramley Moore Dock, and about the middle of the line. At this station are three engines, each capable of working up to 400I.H.P., and each driving a separate Elwell-Parker dynamo. The electricity will be carried north and south along the railway by a steel conductor, placed on porcelain insulators, supported upon cross timbers between the rails of each line. Hinged collectors of cast iron, sliding upon this conductor, will make the connection between the motors upon the train and the dynamos at the generating station. The motors are not placed (as on the City and South London Railway) upon a separate locomotive, but are carried by the passenger carriages themselves. A train will consist of two carriages, each to seat fifty-six passengers, and provided with a motor at one end. The carriages will be so coupled as to give a motor at each end of the train, and the motors will be so connected together as to be controlled from either end by the driver, who will always travel at the front end, changing ends upon arrival at a terminus, and carrying with him a key without which the motors cannot be operated.

All the carriages will be exactly alike, and will contain compartments for two classes of passengers, with through communication from end to end of the train under the control of the guard. A train loaded with passengers will weigh about 40 tons. The trains will be lighted by electricity, and are fitted with the Westinghouse brake, deriving its compressed air from a reservoir on the train, the reservoir being charged after each journey. This system of working the brakes has been found to answer well on the City and South London Railway. The generating station will contain at first six boilers of the Lancashire type, each 30ft. long by 8ft. in diameter, with a working pressure of 120lb., and stoked mechanically. The engines are horizontal compound condensing, by Messrs. John Musgrave and Sons, Bolton. It is intended to commence running with a five minutes' service of trains, but the generating plant is designed to be capable of working a three minutes' service, and the journey from end to end of the railway (inclusive of stoppages) is to be performed in half-an-hour. There are thirteen stations upon the dock portion of the line, and a novel feature on the railway will be a system (Timmis') of automatic signals at all the intermediate stations, in place of the ordinary signalling arrangements. These signals will be electrically worked by the trains themselves, and considerable saving in the working expenses will result.

The permanent way, it will be noticed, is of a novel construction. Longitudinal sleepers, resting directly upon and keyed to the arched decking, support the rails and the electric conductor. As already stated, there is no ballast between the permanent way and the structure, and the working charges in connection with the maintenance and repair of the permanent way should be exceptionally light. The total cost of the railway, including equipment, will be about £85,000 per mile. Mr. J. W. Willans is the contractor for the works, and the Electric Construction Corporation, Wolverhampton, is providing the electrical equipment and the carriages. The engineers, Sir Douglas Fox and the author, have been represented on the work by Mr. Francis Fox and Mr. S. B. Cottrell, and Mr. F. Hudleston has had charge of the work (for Mr. Willans), and to him is due the credit for the design of the tilting and swing bridges referred to. It is intended to open the line for traffic very shortly.

* Paper by Mr. Greathead, read before the Iron and Steel Institute.

Metal Trade Memoranda.

The value of the gold exported from Cape Colony during the month of September amounted to £1,091,000.

The two blast furnaces at the Rhenish Steelworks produced 124,814 tons of Thomas pig iron during the past year.

Mr. J. H. Pearson is about to relight his two furnaces at Netherton, they having been damped down for reconstruction.

The Steel Company of Scotland last week set an additional rolling mill of large capacity in operation at its Blochairn works.

At the North-Eastern Steelworks, Middlesbrough, a mixing plant, similar to that put up at the Eston Steelworks, is now being erected.

M. Auguste Gubler has been granted a concession of the territory of Coman by the Chilian Government for a period of 50 years. He undertakes to develop the district, which is believed to contain gold, silver, copper, and iron.

The accountants to the Midland Iron and Steel Trade Board have issued their certificate of the average prices of finished iron obtained during July and August. This shows a net average of £6 6s. 9d. per ton, compared with £6 7s. 6d. for the two previous months, and £6 4s. 10d. a year ago. Thus there is an advance on the year of nearly 2s., but a decrease on the May and June return of 9d.

The return by Mr. Waterhouse to the Northern Iron and Steel Trades Conciliation Board shows the net average prices of iron bars, angles, plates, and rails, for July and August, to have been £5 7s. 5d., a reduction of 2s. 4d. This involves a decline of $2\frac{1}{2}$ per cent. in ironworkers' wages on the sliding-scale, leaving the wage rate 10 per cent. above the minimum. The production of 40,000 tons was double that in each of the two previous returns, when the Durham strike limited production.

The Metal Market.

PRICES CURRENT.

LONDON, October 3.

COPPER opened with £45 paid for three months, and developed a strong market on good buying for America and Paris, combined with more speculative interest generally. Three months steadily stiffened to £45 6s. 3d., the latter being paid after the official close, and cash made £44 12s. 6d. to £44 15s., urmenate 96¾ per cent. guaranteed, making £44 17s. 6d. for delivery in Liverpool in one week. The close is steady at 10s. advance. Sales, 1600 to 1700 tons. Settlement price, £44 15s. Columbian matte was recently sold at 9s. 1½d. per unit, and to-day a small quantity of Argentiferous changed hands at 9s. 3d. English tough, £47 10s.; best selected, £48 15s.; strong sheets, £56 5s. Messrs. H. R. Merton and Co. return the Chili charters for the past month at 1750 tons, against 3650 tons last month. Messrs. James and Shakspeare give the receipts in England and France over the same period at 1730 tons, and deliveries 9016 tons, making a decrease in stocks on the month of 1286 tons. The total visible supply is 58,482 tons, against 60,301 tons a fortnight since, and 59,449 tons a year ago.

TIN began at £93 10s. for six weeks, and shortly afterwards £93 5s. to £93 7s. 6d. was paid for cash. The better general feeling, moderate shipments, and sympathy with copper induced a good speculative demand, £93 17s. 6d. being freely paid for three months, and cash sold at £93 10s. to £93 7s. 6d., a fair line being taken at the lower price, and the market closed with buyers at the quotations, which are 15s. better on the day. Sales about 200 tons. Settlement price, £93 7s. 6d. English ingots, £96 to £96 10s.

PIG IRON opened with bids of ½d. above Friday's cash prices, and 41s. 11½d. was afterwards offered for one month. Holders, however, were not sellers at these prices, and eventually 41s. 11d. cash in a week was paid. Scotch closed 2½d. to 3d. better, but Middlesbrough and hematite had only a nominal value. Settlement price, Scotch, 41s. 11d.

TINPLATES quiet. I.C. cokes, f.o.b., London, 12s. 6d.; Liverpool, 12s. 3d.; Swansea, 11s. 9d.

LEAD remains firm, and business has been done for early delivery at £10 12s. 6d., closing 2s. 6d. higher, with sellers of Spanish at £10 15s. English, £10 17s. 6d.

SPELTER is quiet but steady at £18 5s. for October shipment. Silesian speciale, £18 10s.

ZINC SHEETS.—Silesian steady at £21 10s., ex-ship, for ordinary. V.M. brands, £21 12s. 6d. ex-ship.

ANTIMONY is offered at £43 5s. for good ordinary.

QUICKSILVER is unchanged: First hands, £8 7s. 6d.; second hands, £6 5s. to £6 5s. 6d.

OFFICIAL CLOSING QUOTATIONS.

	£	s.	d.	£	s.	d.
COPPER—						
G. M. B.—Cash	44	15	0	45	2	6
" Three months	45	5	0	45	12	6
English tough	—	—	—			
Best selected	—	—	—			
Strong sheets	—	—	—			
TIN—						
Fine foreign—Cash	93	7	6	93	17	6
" " Three months	93	17	6	94	7	6
Australian—Cash	93	17	6	94	7	6
PIG IRON—					s.	d.
Scotch warrants—Cash					41	11
" One month					42	1½
Middlesbrough—Cash					Nom.	
" One month					Nom.	
Hematite—Cash					Nom.	
" One month					Nom.	

GLASGOW, October 3.—A very firm tone ruled on the pig iron market to-day. The continued withdrawals of Scotch from store caused "bears" to cover, and the price for cash iron advanced to 42s., leaving off ¼d. under the best. Some 10,000 tons changed hands. Both Cleveland and hematite were firmer, though only one lot of the latter was sold. At the last Cleveland was marked 3d. and hematite 5d. up. The shipments of Scotch last week were 8496 tons, being an increase of 288 tons on the corresponding week, and making the increase for the year 29,871 tons.

QUOTATIONS.

	Highest.		Lowest.	
	s.	d.	s.	d.
Scotch warrants—Cash	42	1	41	9½
" One month	42	2	42	0
Middlesbrough—Cash	39	6	39	6
" One month	—		—	
Hematite—Cash	49	10	49	8
" One month	—		—	

Official Gazette.

Scotch Sequestration.

T. FORREST, Glasgow, engineer, October 5, at 12, Faculty Hall, Glasgow.

Adjudications.

B. C. BADHAM (trading as B. C. Badham and Co.), Featherstone Buildings, Holborn, W.C., sanitary engineer.

H. HOPPER, Ilkeston, Derbyshire, and Cossall, Nottinghamshire, lace manufacturer and engineer.

J. H PAGE, Fowey, machinist and engineer.

W. STAFFORD, Birmingham, iron and steel merchant.

THE BANKRUPTCY ACTS, 1883 AND 1890.

Receiving Orders.

W. STAFFORD, Birmingham, iron and steel merchant.

E. TEGGIN, Manchester, engineer.

New Companies.

NEW ELECTRICAL METALLURGICAL SYNDICATE LIMITED.—This company was registered on the 28th ult., with a capital of £10,000, in £1 shares, to acquire certain patents relating to the production of metals by electrolysis, and the recovery and purification of the bye-products arising therefrom, and apparatus therefor.

HOLT, WILLETT AND SONS LIMITED.—This company was registered on the 23rd ult., with a capital of £1000, in shares of £125 each, to carry on the business of manufacturers and importers of Weston's patent pulley blocks, Moore's epicycloidal and helical, Swalwell and Moore's, and other pulley blocks, warehouse lifts, and elevators and hoists, etc.

NEW SULPHUR RECOVERY SYNDICATE LTD.—This company was registered on the 28th ult., with a capital of £10,000, in £1 shares, to acquire certain patents and inventions relating to an improved process for the recovery of sulphur and the recovery and purification of the bye-products arising therefrom, and apparatus therefor, and as dealers in aluminium, magnesium, etc.

THE CARBON BATTERY COMPANY LIMITED.—This company was registered on the 28th ult., with a capital of £10,000, in £1 shares, to manufacture, sell, and deal in electricity and the bye-products arising from the manufacture thereof, and to manufacture, sell, and deal in aluminium and other metals alloyed with aluminium, magnesium, and other metals, and in chemical and other substances arising out of the manufacture, or otherwise, in the United Kingdom and in the Eastern Hemisphere; to purchase or otherwise acquire letters patent for an improved process for the manufacture of electricity from carbon, the recovery and purification of the bye-products arising therefrom, and apparatus therefor, etc.

DIBASIC IRON AND STEEL (PIONEER) COMPANY LIMITED.—This company was registered on the 24th ult., with a capital of £200,000, divided into 100,000 shares of £2 each, to acquire certain patents, licences, concessions, etc., conferring an exclusive right to use any inventions as to improvements in the manufacture of steel or iron, and for that purpose to acquire the inventions of Messrs. John Heaton and G. H. Holden, of 41, Corporation-street, Manchester, civil engineers, in accordance with an agreement expressed to be made between Messrs. J. Heaton, G. H. Holden, S. Court, J. Flather, and John Laurie Martin, of the one part, and this company, of the other part; generally to carry on business as ironmasters, miners and smelters, iron and steel converters, ironfounders, metal workers, engineers and boiler makers, colliery proprietors and coke manufacturers, wood workers, gas makers, electricians, manufacturing chemists, shipowners, wharfingers, dock owners, and merchants; to lay out land for building purposes, to establish and maintain roads, rail and tramways, bridges, canals, docks, wharves, water courses, hydraulic works, gas works, electric works, factories, warehouses; the promotion of companies, and the general business of a financial agency.

THE EXCELSIOR STEEL AND IRON COMPANY LIMITED.—This company was registered on the 22nd ult., with a capital of £5000, in £10 shares, to conduct and carry on, at such place or places in the United Kingdom, or elsewhere, as may from time to time be determined by the directors, all or any of the following trades or businesses:—Ironmasters, colliery and mine proprietors, steel makers, steel converters, metal founders, miners, smelters, tinplate workers, mechanical, manufacturing, gas, water, civil, marine, electrical, and general engineers, etc.

BROOKES AND COMPANY LIMITED.—This company was registered on the 23rd ult., with a capital of £5000, divided into 2000 preference shares of £1 each and 3000 ordinary shares of £1 each, to purchase and carry on the business heretofore carried on by Messrs. Brookes and Co., wire and iron workers, and to acquire the leasehold premises at Cateaton-street, Manchester, and Springfield-lane, Salford, on which the said business is now carried on, and to acquire and undertake the whole or any part of the assets or liabilities of that business, or in connection therewith, and to enter into and carry into effect, with or without modification, an agreement to be made between Messrs. A. W. Brewtnall and H. W. Brewtnall, of the first part, and Mr. C. J. Brewtnall, of the second part, and Messrs. Brookes and Co. Limited, of the third part

BATES STEEL COMPANY LIMITED.—This company was registered on the 22nd ult., with a capital of £350,000, in 35,000 shares of £10 each, to carry into effect an agreement made between Mr. W. R. Renshaw, of the one part, and this company, of the other part, for the acquisition of certain patents, patent rights, etc. granted to Mr. F. R. Bates), relating to an improved process for the preparation of material for use in converting iron or low-grade steel into high-grade steel, and to develop and turn to account the same; as steel makers and converters, coal and iron masters, engineers, tool-makers, chemical manufacturers, colliery proprietors, metallurgists, etc., and to carry on the business of an electric light and power company in all its branches; to acquire lands and other property of any description, and to develop and turn the same to account in such manner as the company may deem expedient; to search for and render marketable cryolite or any other material containing alumina, iron, etc.; to establish and maintain railways, tramways, wharves, piers, etc.; roads, warehouses, etc.; as shippers and shipowners; as company promoters, and the general business of a financial agent.

Letters to the Editor.

*** *We do not hold ourselves responsible for opinions expressed by correspondents.*

*** *The name and address of the writer (not necessarily for publication) must in all cases accompany letters intended for insertion, or containing queries.*

*** *Letters intended for publication in the current week's issue must reach our Manchester Office not later than by the first post on the Tuesday preceding the date of publication.*

CONSTRUCTION AND EFFICIENCY OF LOCOMOTIVE BOILERS.

To the Editor of THE MECHANICAL WORLD.

SIR,—In the thirty-fifth line of my letter, on page 127, the word *during* should read *owing to*, which your readers will at once see makes a great difference. I am pleased to see that my letter has brought communications from two such correspondents as "J. D. T." and E. Gobert; but I regret to inform the former that as I found in the earlier stages of my career that Latin would assist me very little in my business as a practical boiler maker, I did not pursue the study of the language, and therefore, probably like many of your readers, I *may* enjoy the appearance of his Latin quotation (it certainly looks well), but I understand it not. My letter was a comment on what had previously appeared, including both "reckless expenditure" and "bad design." Certain practices have, we know, been for many years discredited, including "longitudinal lap seams"; but the worst part of the business is that firms still use them, and then even dare to call it first-class work. What I really wanted to show was that the essayist had not correctly described what really takes place either in making or working a longitudinal lap joint. It is all very well to slight or disregard a reserve of "dead supply," but even this reserve will, when kept well above the water level, make a marked difference in the wetness of the steam, while the water plane, or steam-giving surface, must of necessity be increased with a wider fire-box shell; and I never yet saw a high box which was not also wider than the barrel. With respect to drilling roof bars, this is a product of the imagination of "J. D. T.," as such a course would never suggest itself to me in the face of all our modern appliances for stamping, forging, and casting in mild steel. When properly made and applied, a good girder stay (perhaps not a pretty one) is made by placing two flat bars on edge. This is really the cheapest girder stay that can be made, and if "J. D. T." knows much about dirty feed water, he will know that such a girder stay possesses an advantage of no small importance. With respect to the load on the sling stays I may say that from what I have seen in this direction I am strongly of opinion that the only time these slings are free is when steam is being raised, or when fires are being unduly forced. Certainly the firebox is hotter than the firebox shell, but there is not as much of it; therefore the difference in temperature is partly met by the difference in area influenced. I quite agree with him as regards oval tube holes, and I think this defect may yet be remedied. With respect to narrow water spaces, I would ask your readers to understand that I do not consider these possess any advantage whatever, but I do not blame them for broken stays. If water is used containing a fair quantity of deposit, bulging, burning, and breaking of stays may be experienced to a greater extent than if wide spaces were used; but the breaking of stays to which I referred was the breaking without overheating or bulging being visible; and I can give instances where stays were continually breaking with no trace of the cause, and this was only remedied by a new firebox and shell, with stay holes drilled and tapped by the latest machinery and appliances.

RIVET.

Manchester, Oct. 3.

MACHINE CONSTRUCTION.

To the Editor of THE MECHANICAL WORLD.

SIR,—In your issue for August 26, 1892, you illustrate (Fig. 395) an arrangement by means of which a pressure produced in a certain plane is transmitted to a part situated in another plane parallel to it. Allow me to say that the arrangement illustrated is not intended to work a feed pump, but a slide valve. It is a very common device with foreign locomotive engineers. The distance between the parallel arms or planes is frequently more than 7⅞in. The valve gear being quite outside, as the eccentrics are keyed on a return crank, such is the expedient which must be resorted to. The same applies to valve gears, in which the eccentrics are keyed behind the outside driving cranks. In this case, however, the arrangement is reversed, for the main spindle or rod is inside, and not outside.

An explanatory footnote to this effect is found in the first edition of Reuleaux's "Konstruktein."

E. GOBERT.

South Tottenham, Oct. 1.

Miscellaneous Items.

The annual report on the railways in Victoria shows that the profit on the working of the lines is £900,000, but that there is a loss of £400,000 after paying interest on loans.

The automatic hot-water fountains are being rapidly erected all over Paris. The price of two gallons will be a halfpenny. One of the chief results of the new system will be the effectual warming of cabs during the winter months.

At the Howth Baily Lighthouse Mr. Wigham has a new gas burner and a novel arrangement of lenticular apparatus constructed to suit the burner. By means of the new "Intensity" burner the light is doubled by the aid of naphthaline vapour.

A company is being formed at Gothenburg, Sweden, for utilising the Great Trollhätta Waterfall, near the city, for lighting and electromotor purposes, and from a canvass made it appears that the demand will amount to 5262H.P. for motive purposes, 8395 glow and 178 arc lamps.

The United States Government have applied to the Norwegian Government for the loan of the original Viking ship found at Gogstad for exhibition at the Chicago Exhibition. It is thought that the application will be refused, on account of the risk incurred by its transport across the Atlantic.

The new electric tramcars will shortly be at work on the Wednesbury and Bloxwich and Darlaston and Walsall sections of the South Staffordshire Tramways Company. One of the cars has been delivered to the Darlaston depôt. From platform to platform it is 22ft. long, and will accommodate 40 passengers.

An electric recorder for registering the output of ore has been installed on the pit head of a Belgian lead mine. Each load of ore delivered at the top of the shaft completes a connection to an electro-magnetic mechanism, and marks a red line on a sheet of paper moved by a revolving barrel in the ordinary manner of registering instruments.

The oil fuel used in a copper-smelting works at Kedabeg, in the Caucasus, is pumped to an elevation of 328ft. through 15 miles of 4in. steel pipe. The pipe is seamless, not quite ¼in. in thickness, and each length was tested at the factory under a pressure of 30001b. to the sq. in. It was rolled from the solid bar by the Mannesmann process.

The Liverpool Mersey Dock Board contemplate the construction of a new landing stage at the extreme north end of the river, so that passengers by the Atlantic liners may depart at all states of the tide, while the North-Western Railway Company propose to construct a short line of railway to connect the stage with all parts of their system.

A table has been recently compiled by Lloyd's Register showing the nations owning very rapid merchant steamships. Twenty-nine steamers are named, each of which is of at least 19-knots speed. Of these 15 belong to the United Kingdom, 5 each to Germany and Belgium, 3 to Holland, and 1 to France. Some are engaged in river and channel traffic; but a dozen are in the Atlantic trade.

Some interesting experiments in submarine lighting have been made at Toulon. An electric lamp was lowered in the roadstead, and illuminated the sea-bed and the water around it to a distance of more than 100ft. Great quantities of fish, attracted by the light, performed rapid evolutions around the lamp. The submarine lamp may be put to an excellent use by naturalists, to whom it will render valuable service in the study of marine fauna and flora.

Queries.

☞ Readers are invited to avail themselves of this section for practical information on questions relating to Mechanical Engineering and the Scientific Industries.

☞ Queries and Replies should arrive at the Manchester Office not later than by the first post on the Tuesday preceding the date of publication.

PLUMBERS' UNION.—Required the address of the secretary of the Operative Plumbers' Union.—PLUMBER.

WOOD PULP.—Can any correspondent inform me of any process for softening oak chips or shavings into a pulp?—R. C.

COATING FOR WATER PIPES.—Can any reader tell me how to ascertain whether cast-iron pipes have been properly coated with Dr. Smith's solution?—WATER PIPE.

GAS ENGINE.—Will any reader inform me how the valves of a gas engine are set when in the shop, more especially the Otto type? An answer would greatly oblige.—GAS ENGINE.

MOULDING SAND.—Will any reader inform me where the fine moulding sand is obtained, the same as used for making small malleable iron castings in?—WALSALL IRON FOUNDER.

MARINE ENGINEERS' EXAMINATION.—Will any reader inform me of the qualifications of an engineer on board ship? How such situations are obtained, and particulars of examination?—A. G. K.

SPEED OF LOCOMOTIVES.—Provided a railway line is laid as perfect as possible, can any engine attain such a velocity as to cause it to leave the rails owing to excessive speed only?—P. T. G.

ROLLING CONTACT.—Can any reader kindly inform me if there are any machines in use for any purpose which have two rollers, cylinders, or the like, revolving in opposite directions at the *point of contact*?—W.

INJECTOR.—Will any engineer give me reliable data for calculating the quantity of steam it would require to work an injector that would lift 1000 gallons of water 10ft. high in one hour, into a tank or empty boiler?—G. A. B.

HARDENING AND TEMPERING.—Can any reader inform me how to harden and temper a number of straight steel wires 13 gauge and 16in. long? I have tried several ways, but I cannot keep them straight. I may say that I have hardened them in oil, and one at a time.—BLACKSMITH.

LOSSES IN STEEL FURNACES.—Could any reader kindly inform me the average per cent. of actual loss, and the average per cent. of skull, in the charge of a Siemens open-hearth steel furnace working charges of from 30 to 40 tons? And also the percentage of loss in heating slabs and ingots in the Siemens regenerative gas furnace?—J. R. R.

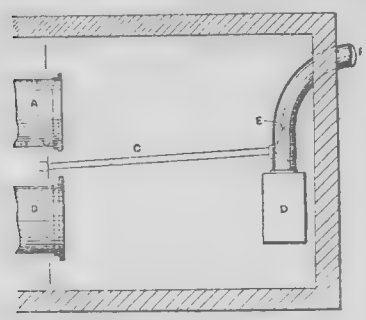
PEAT COAL.—I shall be very pleased if any reader of your valuable paper can give me some information on the above subject. I am desirous of knowing what firms manufacture it; its properties as a heating agent; what is its heating power in comparison with ordinary good coal; would it be a cheap fuel for firing boilers?—J. W. GEMMEL.

BOAT PROPULSION.—If a boat floats down a river, will it be carried forward at the same speed as the stream is flowing? Or can it be proved that it will go slower than the stream? How much force in lb. will be required to propel a boat of a given weight against a stream or up a river flowing with a certain velocity, so that the boat shall move up the river with the same speed that the stream is flowing down?—HYDRA.

CUTTING CHASERS.—Can any reader inform me what method is used by Sir J. Whitworth and Co. to cut up their screw chasers, both inside and out? Or can any reader advise me as to the best method of cutting up inside and outside chasers when high-class mechanical efficiency is required, such as would be necessary in making standard gauges? Is there any method by which one can ensure a chaser retaining its proper angle after going through the hardening process?—A KIRBY.

CONDENSER FOR MILL ENGINES.—Can anyone give me information, from practical experience, about a form of condenser called the evaporative or open air condenser, for use where water is scarce and expensive? A number of pipes in communication with each other are fixed over a large shallow tank and exposed freely to the atmosphere. The insides of the pipes are in communication with the exhaust steam pipe and the air pump. On the outsides jets of water flow, a portion of which is evaporated and flies off as steam. Required to know whether perfectly successful and satisfactory in use. Whether, if fixed upon the engine-house roof, the nuisance from the steam flying off would be greater than that from a non-condensing engine exhaust pipe when exhausting into atmosphere. Approximate cost for 200I.H.P. Surface of pipe required per I.H.P. Best size of pipe to use. Whether any expense or trouble to keep in working order. Whether a new idea. I have been informed that the quantity of water required for this condenser does not exceed one-half the amount used by a non-condensing engine of same power *for boiler feed alone*, the only loss being that evaporated from the surface of the pipes, the condensed water being used in the boiler over again, as in the case of the ordinary surface condenser. Any information will be much appreciated.—CONDENSER.

STEAM JET.—Will any reader kindly enlighten me as to some plan for discharging ashes from the stoke-hole of a boiler house by means of a steam jet? My idea of such an arrangement will be best shown by the accompanying sketch, which is a plan of the front end of the boiler house. A and B are two Lancashire boilers, each about 28ft. × 7ft. diameter, and working at a pressure of 60lb. C, steam pipes from boilers ending in a nozzle E, which is inside the discharge pipes F. D is an iron box with a suitable air-tight lid. The ashes to be



discharged are emptied into the box D and the lid closed. Steam is then allowed to blow through the nozzle E. The suction thus caused is supposed to draw the ashes from D, which are then blown out through the discharge pipes F by the steam jet at E. In my case the vertical height from D to the point where the ashes would be discharged outside the boiler house would be about 13ft. A sketch with sizes of steam pipes, ashbox, and discharge pipes, would greatly oblige.—G. A. B. M.

Replies.

☞ Owing to the constant increase in our correspondence, we regret that we have no alternative but to announce that we cannot reply by post to Queries even when stamped envelopes are sent.

☞ Queries and Replies must in all cases be accompanied by the names and addresses of the writers, as no notice will be taken of anonymous communications.

HEAT.—About 160ft.

A. DODD.—You do not give any address.

OLD BEAM ENGINE.—The correction is not of importance.

BURNLEY.—Your idea, as now explained, is quite impracticable.

D. A. MORTON.—We do not think the figures you require are available yet.

EXCELSIOR.—We would advise you to apply to the secretary, 10, Victoria Chambers, Westminster, London, S.W.

H. BURKE.—Try Messrs. J. Pickles and Son, Hebden Bridge, or Messrs. Thomas Robinson and Son, Rochdale.

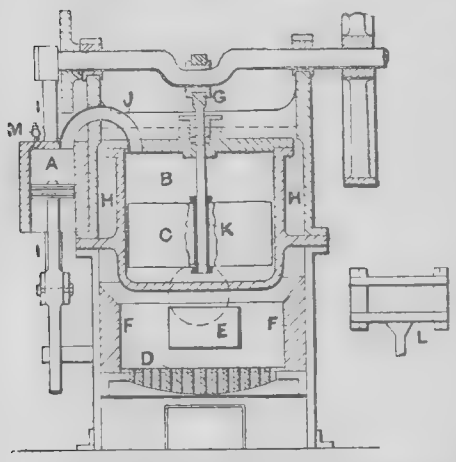
INVESTIGATOR.—Are you obliged to use a metal? Would not steatite (soapstone), such as gas jets are made of, answer your purpose?

CONSTANT READER.—You do not give the cut-off, so we cannot calculate the horse-power. Jamieson's book will best meet your requirements.

H. SCOTT (Leeds).—Messrs. Thwaite Brothers, of Bradford, will supply all particulars of the cupola and engines. The dates you require are:—July 4 and 25, August 28, September 18, October 16, December 18, 1891.

J. ROBERTSON.—The time of exposure to the hardening process will depend upon the depth you wish the steelifying action to penetrate. Try samples for various periods and break them across, when you will be able to see the depth of the steel face. You may immerse them in cold water together.

HOT-AIR ENGINE.—Will some reader of THE MECHANICAL WORLD kindly oblige me with a section and principal dimensions of a ½H.P. single-acting hot-air engine of the Stirling cycle?—GEO. H. PERKINS, North Queensland.——A.—In reply to Geo. H. Perkins, I send a section and description of a ½H.P. hot-air engine. A is the working cylinder, of cast iron, 3in. diameter by 4in. stroke. The heating



chamber B is also of cast iron, with displacer C made of sheet iron, and is filled with asbestos fibre; K is a piece of tube to support the ends where the rod goes through; D, fire grate; E, fire door; F, firebrick lining; G is the displacer crank. The crosshead crank is 1in. throw. A side view of the crosshead is shown at L. H is a water space around the heating chamber, which is filled to the dotted line; I is a kite-shaped connecting rod; J connecting pipe from heater to cylinder; M is a stop-cock, to be opened to stop the engine. I should have said the displacer C is to be ¾in. less in diameter than the heater B.—T. MANWARING.

Prize Competition.

WE OFFER FOUR GUINEAS MONTHLY IN PRIZES FOR THE BEST ORIGINAL ARTICLES SENT IN ON ANY MECHANICAL, ENGINEERING OR ELECTRICAL SUBJECT.

IN ORDER THAT MANAGERS, DRAUGHTSMEN, FOREMEN, AND WORKMEN WHO HAVE HAD NO PRACTICE IN WRITING MAY NOT HESITATE TO SEND IN COMPETITIONS, IT IS TO BE UNDERSTOOD THAT ALL ARTICLES WILL BE FULLY EDITED AND CORRECTED, AND JUDGED OF SOLELY ON THEIR MERITS AS ORIGINAL CONTRIBUTIONS FROM A PRACTICAL POINT OF VIEW. THE OBJECT OF THE COMPETITION IS TO INDUCE PRACTICAL MEN TO COME FORWARD AND GIVE THE RESULTS OF THEIR EXPERIENCE.

CONDITIONS.

Competitions for our Monthly Prizes must be sent so as to arrive at the Manchester Offices of THE MECHANICAL WORLD, New Bridge-street, not later than the last Tuesday in each month. Articles arriving after that time will be placed in the following month's competition.

Written competitions must be on one side of the paper only. The contributions must be original, and relate to matters connected with Engineering, Mechanism or Electricity.

The Proprietors of THE MECHANICAL WORLD reserve the right to publish any competition, whether it gains a prize or not.

The competitions may be accompanied by diagrams, sketches or drawings.

Competitors should write the words "Prize Competition" on the envelopes.

Competitors are not confined to one, but may send any number of competitions.

The correct name and address of the sender *must* be distinctly written upon every competition, not necessarily for publication. Competitions can appear under a *nom de plume*.

☞ We cannot undertake to be responsible for any MSS. sent to us, though when stamps are enclosed for the purpose we will endeavour to return rejected contributions.

Latest Inventions.

APPLICATIONS FOR LETTERS PATENT.

When Patents have been "communicated," the name of the communicating party is printed in italics.

Where complete specification accompanies application, an asterisk is suffixed.

19th September, 1892.

16,677 MOTOR for OPERATING the SPINDLES of WOOD-CARVING MACHINES. A H Tyler.

16,686 AUTOMATIC LUBRICATOR for LOW-PRESSURE ENGINE CYLINDERS. W Hargreaves.

16,689 STEAM BOILERS. J Partington.

16,690 STEERING GEAR for FISHING BOATS. J D Jack and R H N Sellar.

16,692 ELECTRICAL APPARATUS for SIGNALLING or SPEAKING BETWEEN SHIPS or BETWEEN SHIPS and the SHORE, ETC. S F Wallner.

16,694 CARBON LAMPS or CARBON BURNERS. B Radcliff.

16,696 MACHINE for BREAKING PIG-IRON MOULDS. J W Armstrong and T James.

16,700 ELECTRIC FIRE ALARMS. R Wood. (*E Hoyle*, Russia.)

16,703 COMBINED RULE and SQUARE. W McNeill.

16,708 ENGINEER'S POCKET GAUGE. G H Bruce.

16,716 SHEATHING and PROTECTING STEEL, IRON, and INSULATED COPPER WIRE. G France and R Dyson.

16,718 CLIP for CONNECTING HOSE to METAL PIPES. W W Macrow.

16,721 EDGE RUNNERS or VERTICAL MILLSTONES.* H Mantey.

16,729 RAILWAY SIGNALLING. F A Slater.

16,736 CHIPPING TOOL. A Cruickshank.

16,743 AXLES for TRAMCARS.* A J Boult. (*H Lau*, Germany.)

16,744 STEAM GENERATORS. E C Urry and G A Farini.

16,750 CHARGING MACHINE for GAS RETORTS.* F Grein.

20th September, 1892.

16,754 STEAM ENGINES.* W P Thompson. (*J W Powers*, United States.)

16,759 SAFETY APPLIANCE APPLICABLE for USE IN CASE of FIRES. W P Thompson. (*A Lemouche*, Belgium.)

16,768 ELECTRICALLY CONTROLLED SWITCHING APPARATUS for TELEPHONE EXCHANGES. R Pippette.

16,770 CENTRIFUGALS and OTHER HIGH-SPEED MACHINES. J M C Paton.

16,773 STOP VALVE. J Robinson.

16,775 KEYS for OPENING and CLOSING ELECTRIC CIRCUITS. A Marr.

16,779 STRENGTHENING SHIPS and SUITABLE STRUCTURES. W C Morison.

16,785 FITTINGS for the SUPPORT of ELECTRIC LAMPS. W Defries and V I Feeny.

16,790 WATER MOTOR. W Smith.

16,791 VALVES and FAUCETS.* R Marsh and C S Upton.

16,792 APPARATUS for MANUFACTURING WIRE GLASS.* F Shuman.

16,794 SIGNAL TELEGRAPHY.* C V Boughton.

16,800 RECOVERING COPPER and NICKEL from ORES or MATTERS CONTAINING THESE METALS. J Strap.

16,805 PORTABLE ELECTRIC SEARCH-LIGHT APPARATUS. R A Scott.

16,807 SLIDE RULES and OTHER CALCULATORS. W T Goold.

16,808 ROPE-GRIPPING DRIVING PULLEY. G Barrett.

16,818 DRAIN, WATER, GAS, and OTHER PIPES. W Knightly.

16,820 TELEGRAPHIC and TELEPHONIC APPARATUS for ESTABLISHING COMMUNICATIONS BETWEEN SIGNAL BOXES and TRAINS.* J D Hickman.

16,821 WATER MOTORS.* L Porter and the Malden Machine Company.

16,822 ELECTROLYTIC APPARATUS.* T Craney.

16,824 SCREW PROPELLERS for STEAMSHIPS.* D Urch.

16,828 STAMPING or PRESSING of METAL. F Bidtel.

16,831 METALLIC RAILWAY TIES.* C B Macneal.

16,833 BREAK FEED APPLIANCES for ELECTRIC ARC LAMPS. F J Beaumont.

21st September, 1892.

16,841 WRENCH. S P Wood.

16,845 ENGINE GOVERNORS or SPEED REGULATORS. J and A Prentice

16,846 APPLICATION of NUMBERS to all KINDS of LINEAL MEASURING APPARATUS to FACILITATE the COMPUTATION of SQUARE and CUBIC QUANTITIES. C Manners, jun.

16,852 PACKING for PISTON RODS, VALVE SPINDLES, and PUMP RODS. J E Hopkinson.

16,855 CARTRIDGE CASES. G Hookham.

16,865 PUMPS. W Ainsworth.

16,866 ELECTRODE PLATES for SECONDARY BATTERIES. A Müller.

16,875 ENVELOPE MACHINES. (*L P Bouvier*, Canada.) H F Redfern.

16,877 SIGNALLING APPARATUS for TELEPHONES. Sir C S Forbes, Bart.

16,878 PLATES for SECONDARY BATTERIES. E Bailey and J Hall.

16,879 MINERS' ELECTRIC LAMPS. E Bailey and J Hall.

16,880 APPARATUS for PLANING or SHOOTING MITRES. A E Mears.

16,892 APPARATUS for the EXTRACTION, SEPARATION, and REFINING of METALS by ELECTROLYSIS. D Tommasi.

16,893 APPARATUS for the EXTRACTION, SEPARATION, and REFINING of METALS by ELECTROLYSIS. D Tommasi.

16,894 EXTRACTION of GOLD and SILVER from ORES. J C Montgomerie.

16,895 CENTRIFUGAL MACHINES.* R Kron and J Schmerber.

16,902 ADJUSTABLE or SHIFTING WRENCHES.* H H Lake. (*S W Wardwell, jun.*, United States.)

16,903 ELECTRIC ACCUMULATORS. H H Lake. (*F C Jenkins*, Germany.)

16,904 AUTOMATIC SWITCH for ELECTRIC and OTHER LIGHT APPLICABLE to a DOOR. J Hopwood.

16,905 PERMANENT WAY of RAILWAYS. G E Moore.

16,906 AUDIBLE TELEGRAPHS. R R Harper.

22nd September, 1892.

16,908 BOATS PROPELLED by STEAM or OTHER MOTIVE POWER ENGINES. H A House, sen., and others.

16,909 BOILERS or GENERATORS for STEAM and OTHER VAPOURS. H A House, sen., and others.

16,910 STEAM and OTHER MOTIVE POWER ENGINES. H A House, sen., and others.

16,911 BURNERS for the COMBUSTION of GAS or VAPOURS for HEATING PURPOSES. H A House, sen., and others.

16,919 DYNAMO-ELECTRIC MACHINERY, ALTERNATING CURRENT MOTORS, TRANSFORMERS, ETC. J Swinburne.

16,927 PLATE-BENDING MACHINES. W B Thompson.

16,930 SIGNALLING APPARATUS for VEHICLES. F P Slavin.

16,934 VOLTMETERS or ELECTRICAL INDICATORS. W H and R Thompson.

16,937 WIND ENGINES. J Honeyman.

16,940 APPARATUS for the FILTRATION of the FEED WATER of MARINE BOILERS. A Harris.

16,943 SHEARING and STAMPING TOOLS.* H Schurig.

16,945 FURNACES. T S Payne and C Polyblank.

16,946 RIVETING MACHINES. W Skaife.

16,948 MEANS for ENABLING BOATS to be PROPELLED on NAVIGABLE WAYS by ELECTRIC ENERGY. E de Pass. (*E Geisenberger, A Sellier*, and *E Guillemin*, France.)

16,953 STEAM HEATING APPARATUS for RAILWAY CARRIAGES. H Imray. (*E Picard*, Belgium.)

16,959 STEAM HEATING APPARATUS for RAILWAY TRAINS. H Imray. (*E Picard*, Belgium.)

16,956 APPARATUS for REGULATING the TEMPERATURE of STEAM-HEATED STOVES.* O Lindemann.

16,960 CENTRIFUGAL GOVERNORS. A Shaw.

16,964 INSULATING ELECTRICAL CONDUCTORS. S Pitt. (*E C Davidson*, United States.)

16,965 METAL TUBES and SLEEVES. J K Starley.

23rd September, 1892.

16,972 HYDROSTATIC LIFTING JACKS. R Taylor.

16,973 TUBULAR STEAM BOILERS. P Jack.

16,976 HIGH-PRESSURE STOP-COCKS or VALVES. H D Fitzpatrick. (*J Brandt*, Germany.)

16,980 CONNECTIONS for ELECTRICAL ACCUMULATORS. J J Robins.

16,986 IGNITION TUBES for GAS ENGINES.* G Whittaker.

16,992 STEAM GENERATORS and SIMILAR FURNACES. B Peace and E Adams.

16,994 ROTARY ENGINE. J H Peloux.

16,997 ELECTRIC BELLS. T G, R, and R C Usher.

16,999 PREVENTING the BURSTING of WATER PIPES by FREEZING. C Harrison.

17,004 ELECTRIC ARC LAMPS. F D'Artery Goold.

17,008 WATER-TUBE BOILERS. J E Bott.

17,012 DISTRIBUTION of ELECTRICAL ENERGY. G Wilkinson.

17,013 APPARATUS for UTILISING the EXPANSION and CONTRACTION of LIQUIDS for the PURPOSE of DRIVING MACHINERY. C Mackintosh.

17,027 VEHICLE WHEELS and AXLES THEREFOR.* W T Smith and others.

24th September, 1892.

17,029 SHAPING of WOOD or METAL in LATHES and DRILLING MACHINES. C Morehead.

17,033 SAFETY LAMPS. J J Cooke.

17,035 STEAM GENERATOR FURNACE. T Downie.

17,036 REGENERATIVE GAS FURNACES for HEATING RETORTS. J F Bell.

17,038 FURNACES of STEAM BOILER FURNACES. J Platt.

17,049 VALVES for REGULATING the ADMISSION of FLUIDS to the WORKING CYLINDERS of PRESSES and HOISTS. J C Etchells.

17,051 SAFETY CATCHES for the CAGES or PLATFORMS of HOISTS. J C Etchells.

17,053 STEAM BOILERS. J Hood.

17,054 MECHANISM for SHAPING SCREW TAPS. J M Foster.

17,056 STEAM GENERATOR FURNACES. W H Wilson and H Tee

17,057 INDICATORS for ENGINES and PUMPS. A B Dobbie.

17,058 APPARATUS for HARDENING SMALL STEEL ARTICLES. J L Stewart.

17,059 ROTARY MOTORS, PUMPS, BLOWERS, EXHAUSTERS, and WATER METERS. W Smith and T Waddington.

17,062 ELIMINATION of SMOKE and DISPOSAL of FURNACE GASES from STEAM BOILERS and OTHER FURNACES. J E Bott.

17,063 OIL FUEL FURNACES. J E Bott.

17,064 INCREASING the EFFICIENCY of STEAM in MOTIVE-POWER ENGINES. J E Bott and H Cramp,

17,067 GAS. H Collet and M Merichenski.

17,069 SCRAPER for CLEANING BOILER TUBES. S and L C Abraham.

17,085 WATER CIRCULATING PLATES for STEAM BOILERS. W G Gass.

17,086 MACHINE for MOISTENING and PURIFYING AIR.* A Schmid.

17,090 APPARATUS to be EMPLOYED in the MANUFACTURE of METALLIC TAPERED TUBES. W Pilkington and others.

17,091 INSULATING and SUPPORTING ELECTRIC WIRES INTENDED to ACT as RESISTANCES. R E B Crompton and H J Dowsing.

17,092 INSULATING and SUPPORTING ELECTRIC WIRES INTENDED to ACT as RESISTANCES. R E B Crompton and H J Dowsing.

17,093 ELECTROSTATIC MEASURING INSTRUMENTS. W E Ayrton and T Mather.

17,095 RAILWAY ALARM SIGNALS. E Booth.

17,099 CARBON ELECTRODES. H T Barnett.

17,100 APPLIANCES for GETTING DOWN COALS WHERE EXPLOSIVES are NOT USED. W Hall.

17,105 APPARATUS for SUPPORTING TUBULAR ARTICLES DURING the PROCESS of HARDENING. H H Lake. (*G F Simonds*, United States.)

17,107 VALVE MOTION for STEAM ENGINES. F Lamplough and J A Bauer.

17,111 WRENCHES.* C A Maynard.

Manuscript Specifications of Patents can be examined at the Patent Office, London, after the Complete Specification has been accepted, on payment of 1s. The printed Specifications are usually published in about one month after acceptance of the Complete Specification, and any single copy may be obtained by remitting 8d. in stamps (or by special post cards sold at the Post Offices at 8d. each) to SIR H. READER LACK, *Comptroller General, Patent Office, 25, Southampton Buildings, Chancery-lane, London. When a number of Specifications are required, remittances may be made by P.O.O.*

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EDUCATION: As Viewed from a Medical Standpoint By G. E. SHUTTLEWORTH, B.A., M.D., etc., etc.
ADULTERATION OF FOOD, DRINK, AND DRUGS. By CHARLES ESTCOURT, F.I.C., F.C.S.
OUR HAIR: Hints for Men who Don't Want to be Bald.
THE CASTOR-OIL PLANT.
TEETH AND TOOTHACHE.
DISINFECTANTS.
COCOA: Then and Now.
SLEEP: Some Hints for Restless Folk.
PHYSICAL DEVELOPMENT BY ATHLETICS.
FOR OUR BEAUTIES.
ABUSE OF THE BICYCLE.
OUR SKIN.
MOURNING HYPOCRISY: Why Wear Black?
MEDICAL USES OF EGGS.
ENGLISH WATERING-PLACES (ILLUSTRATED): BATH.
DISEASES AND DISORDERS OF THE CHEST.
WATER BRASH.
HEALTH NOTES.
CONGRUITY IN FOOD.
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Every correspondent should forward his name and address, not necessarily for publication unless so desired. We do not undertake to return MSS. unless specially requested, and in such cases stamps should always be sent.

All communications relating to editorial matters should be addressed to the Editor of THE MECHANICAL WORLD, at the Manchester, and not the London, Offices.

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To those advertisers who are being led to believe that the circulation of THE MECHANICAL WORLD is in the North of England, Scotland and Wales only, the Proprietors would state that **11,000** (eleven thousand) copies are disposed of every Thursday over the counter of the London Office alone, to Wholesale Newsvendors there, by whose agency they are distributed throughout the Metropolis, the Southern and Home Counties, Ireland and Abroad.

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FRIDAY, OCTOBER 14TH, 1892.

A New Launch Engine.

A LAUNCH, equipped with one of Root's oil engines, has lately been tried on the Thames, and the results of the trials appear to show that this motor is especially suitable for this particular purpose. This motor, though occupying only a few feet of cubic space, and weighing no more than 6cwt., developed something over 3H.P., and drove the launch at the speed of six miles an hour. The novelty of this engine consists mainly in the mechanical contrivances by which ordinary paraffin oil is converted into gas. A small reservoir containing 2gals. of mineral oil, which is enough for a run of three hours at full speed, is attached to the engine. From this one drop at a time descends through pipes to valves into which heated air is admitted. The air and oil are forced into a space which, by contact with the flame from another jet of oil, is kept always at an even temperature. There the oil is converted suddenly into gas, and passes through a tube to the piston cylinder. By a system of compensating spring valves, on which the lever strikes, gas is admitted into each of two cylinders alternately, and so the motion once begun goes on so long as there is a drop of oil left in the reservoir, unless it is desired that the engine should stop, and then the man in charge has it perfectly under control. In place of an ordinary fire there is merely an oil lamp, into which is inserted a gas burner of peculiar form. From another cylindrical reservoir oil passes to this burner through a siphon and oozes through a small hole scarcely larger than a pin's point. There it becomes converted into gas, and supplies all the heat that is necessary for driving this engine.

The New York Electric Railway.

IN a previous issue it was mentioned that, notwithstanding the outpourings of a large section of the New York press against the trolley system, the Mayor had authorised the adoption of that system. Pending the obtaining of the necessary permission, preparations were made for the carrying out of the proposed electric tramways, and immediately the consent was secured, a small army of men was set to work, with the result that in an incredibly short time a portion of the projected lines was set in operation. This constitutes the first electric railway on the overhead system in New York city. Already several cars are in service on the Third-avenue and Boston-road, these saving half-an-hour on the out and home journey over the horse cars which they have replaced. The railway is the Harlem Bridge and Fordham Electric Railroad, and the plant for working it is formidable—at least, in Europe. It comprises four 500H.P. Babcock and Wilcox boilers, four large compound condensing Corliss engines of 400H.P., and four 300-kilowatt dynamos of the Thomson-Houston type, which are belted direct to the engines. An overhead crane, having a lifting capacity of 30 tons, runs the whole length of the building, and is intended for general work in the station. At present, 20 miles of double line have been laid down, and as many miles of trolley wire suspended. The line is essentially of the Thomson-Houston type with single reduction motors on the cars.

Electric Railway Improvements.

AT the tenth annual meeting of the New York Street Railway Association, held recently at Saratoga Springs, a report was presented by the committee appointed to investigate recent improvements in electric traction. It was pointed out that the tendency has been during the past year or two to adopt a heavier and more solid construction in every department. With regard to the best form of track there was considerable difference of opinion, but Mr. L. H. McIntire, the engineer of the Union Company of New York, said from his experience and observation he was convinced that the deep girder rail, about 9in. high, spiked directly to the sleepers, was the best form for paved streets; in dirt or macadam streets, a 6in. girder rail similarly laid; and in the country a T rail, spiked to the sleepers direct. Dealing with the bugbear of tram lines—namely, the weakness at the joints,—it was mentioned that there were almost as many patents upon rail joints as for car couplers, but most of them were impracticable. Nothing had, however, been brought out up to the present to surpass a properly-designed fish-plate. The greatest advance had probably taken place in armatures for motors and dynamos. The recent introduction of the "ironclad" type, it was considered, had helped to reduce repairs, and this type had now been adopted by traction companies as their standard. In the manner of controlling the motors, most lines used the time-honoured rheostat, but a new kind of controller was about to be tried. Another interesting feature had been the substitution of the post form of car truck for the pedestal type. With the latter the grinding of the gearing was transmitted through the whole car; but with the post form the truck is complete in itself, and the motors are supported directly on the frame of the truck, the body being connected to the latter only by springs, thus being entirely free from the jolting and pounding of the truck. For the overhead construction, stiffer poles, stronger span wires, and better insulators were being used, whilst the best arrangement for feeding the line was to divide the system into several sections, so that in case of necessity any particular section could be disconnected. In the heart of any electric system—that is, the power station—the tendency in all large central stations was to dispense with countershafting, and to use large multipolar dynamos either coupled direct to the engines or driven direct by belting. In conclusion, the committee attributed most of the unsatisfactory work in the past to the rapid growth of the electrical industry, which called into it many people unqualified for the work.

Long-distance Telephony.

THE tendency towards long-distance telephony is becoming more pronounced, and this fact is amply shown by the inauguration at the beginning of this month of a line between Vienna and Trieste, Graz being included. The charge for an ordinary conversation of three minutes between the two former towns is about 3s., whilst between Vienna and Graz, or Graz and Trieste, the rate is about 2s. The opening of this line, which is 314 miles long, is an event of importance in interurban telephony, and it is interesting to note that the length of the line is only exceeded by one other in regular operation in Europe—that is, the Paris-Marseilles, about 620 miles long. The next in importance is the London-Paris service, 310 miles; the Berlin-Breslau line, 219 miles; Vienna-Brünn-Prague, 219 miles; and the Paris-Brussels, 198 miles. It is noteworthy that the line from Vienna to Trieste was commenced in June of last year, when eight sections were proceeded with simultaneously, and was completed at the end of August last, when the first conversation took place. The transmission of speech over the line is said to be remarkably plain and clear, and good results have been obtained over even longer distances.

Dr. Alexander C. Kirk.

WE much regret to have to record the death of Dr. Alexander C. Kirk, which took place on the 2nd inst. Dr. Kirk, who was senior partner of Messrs. R. Napier and Sons, Govan, was born 62 years ago at the Manse of Barry, Forfarshire. He was educated at the Burgh School, Arbroath, and Edinburgh University, and after serving his apprenticeship as an engineer with the firm of which he was latterly chief, migrated to London, where he was for several years in the drawing-office of Messrs. Maudsley, Sons and Field. From the Thames he returned to Scotland, and acted as manager of Young's Paraffin Oil Works at Bathgate, and subsequently at West Calder. From 1870 to 1877 he was manager of the engineering department in Messrs. John Elder and Co., leaving that firm to take up, with the Messrs. Hamilton as partners, the shipbuilding yard and engineering works in Govan long carried on so successfully by the celebrated Napier family. His management of Messrs. Elder's machinery department was signalised by the invention of the triple-expansion engine, a departure which was subsequently followed up in the construction of several of the larger vessels turned out by his own firm.

Railway Accidents in 1892.

FROM the half-yearly report of the Board of Trade on railway accidents, we learn that during the six months ending June 30 last 583 persons were killed and 4839 injured on British railways. The casualties, classed under the several heads, were as follow:—Accidents to trains, rolling stock, permanent way, etc., caused the death of 14 persons and injury to 324, as compared with 7 and 417 in the corresponding period of 1891. During the six months there were reported ten collisions between passenger trains or parts of passenger trains, by which 11 passengers and 1 servant were killed, and 152 passengers and 10 servants were injured; 19 collisions between passenger trains and goods or mineral trains, etc., by which 35 passengers and 10 servants were injured; 6 collisions between goods trains or parts of goods trains, by which 9 servants were injured; 15 cases of passenger trains or parts of passenger trains leaving the rails, by which 1 servant was killed and 27 passengers and 4 servants were injured; 3 cases of goods trains leaving the rails, by which 1 servant was injured; 5 cases of trains or engines travelling in the wrong direction through points, by which 45 passengers and 4 servants were injured; 7 cases of trains running into stations or sidings at too high a speed, by which 22 passengers and 3 servants were injured; 20 cases of trains running through gates at level crossings; 1 case of the bursting of boilers or tubes, etc., of engine, by which 1 servant was injured; 136 failures of axles, by which 1 passenger was injured; 4 failures of couplings, by which 1 servant was killed; 1 case of the failure of a bridge, 154 failures of rails, and 2 other accidents. In addition to these, 282 persons were killed and 441 injured from other causes than accidents to trains, 55 of the killed and 342 of the injured being passengers. During the six months 249 servants of companies or contractors were reported to the department as having been killed and 1269 injured, in addition to those included in the first division—namely, "accidents to trains,"—the grand total being 545 killed and 2034 injured, as compared with 547 killed and 2376 injured in the corresponding period of 1891.

Another Use for Aluminium.

ALUMINIUM is to be employed in a somewhat novel manner in connection with a new sixteen storey building now being erected in Chicago, in which, instead of the usual brick or terra-cotta facing, aluminium plates are to be used. The building itself is of the usual fireproof construction, with iron columns, but the fronts between the windows are to consist of cast aluminium plates about ⅛in. thick, which are to be held in place by strips of cast aluminium. The plates will be about 36in. × 20in., and the holding strips are to be about 6in. wide, and are fastened to angle irons attached to the window casings. The space back of the plate, between them and the columns, is to be filled with fireproofing, and the small spaces back of the holding strips with Portland cement. The composition of the plates and strips is to be about 90 per cent. aluminium and 10 per cent. copper. Another feature of the building, which is almost as striking as the nature of its exterior, is the size of the windows, some of which are 22ft. across. Buildings in Chicago are now limited to a height of twelve storeys, but this building will be built under a permit granted before this regulation was made, and so it can be carried to the full height of sixteen storeys.

A CLEOPATRA'S NEEDLE of red granite, with a pedestal of black porphyry, which has been lying in the garden of the Austrian Consulate at Alexandria for nearly 60 years, is about to be conveyed to Trieste, where it will be erected on one of the quays. This needle, which is upwards of 70ft. in height, is considered by experts to be a finer obelisk than either the London or the Paris one.

BAKU, the oil-producing centre of Russia, has for some time been agitating the matter of establishing a school for instruction, both practical and theoretical, in deep-well boring. Such a school is now to be started. The proposed course of instruction is to be three years. Two years of the course are to be devoted to theoretical studies, and the remaining year is to be spent in practical work. Students of all ages are to be admitted, providing they have a fair, ordinary school education. It is thought that in this way workmen now engaged in well-drilling operations can enjoy the advantages of further training in their line with profit to themselves and the oil-well industry.

The Design and Construction of Stationary Engines.--XXXVII.

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FIGS. 177 and 178 show two simple modifications suitable for the crosshead ends of small rods. The latter makes a neat arrangement for eccentric rod ends or parallel motions. Fig. 179 shows for the crosshead end a similar arrangement to that shown in Fig. 177.

The type of rod end known as the "Marine" end, from being largely used in marine practice, is a very convenient one, and perhaps cheaper to make than any of the others. In this rod the brasses are not held by straps secured by gibs and cotters, but by bolts, as shown in Figs. 179 and 180, 181 and 182. The various examples here given show modifications in detail, but the general principle is the same. In Figs. 179, 180, and 181, the brasses are plain cylinders, split and held in position by the through bolts for the caps being brought together sufficiently close so as to pass through the sides of the brass, which arrangement effectually prevents the brasses turning round or getting out of place. In Fig. 182 the brass steps are formed so as to receive the through bolts, and the back half of the brasses has a projection which is let into a corresponding recess in the palm or foot of the rod, the brasses or steps being held together by a flat bar or cover. This bar is in the condition of a beam loaded in the centre and supported at the ends, and its strength can be calculated by the ordinary formula for rectangular beams. Table XXII. gives the dimensions for a number of sizes of such rods, suitable for the size of engine given in column 1.

(*To be continued.*)

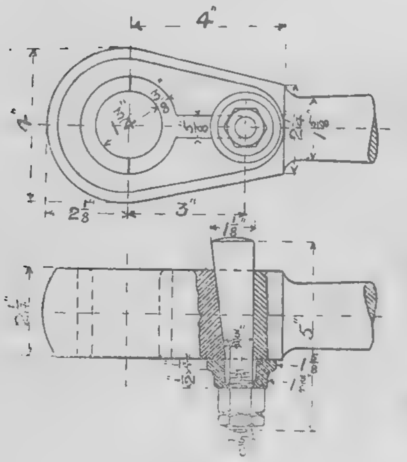


FIG. 177

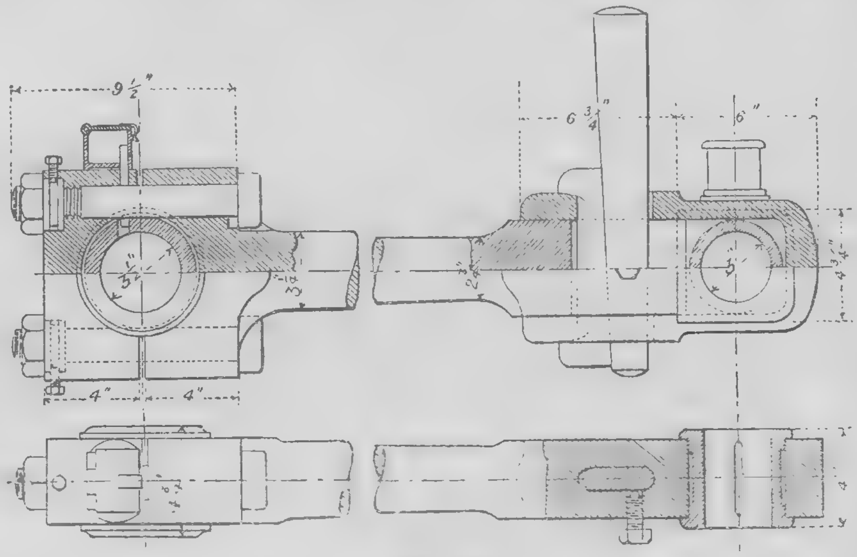


FIG. 180,

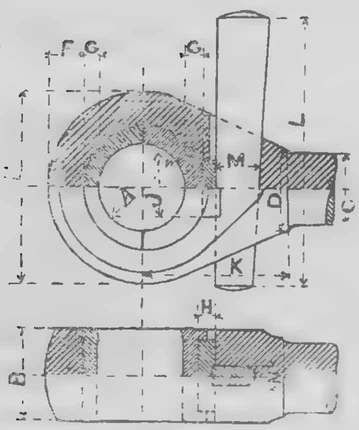


FIG. 178.

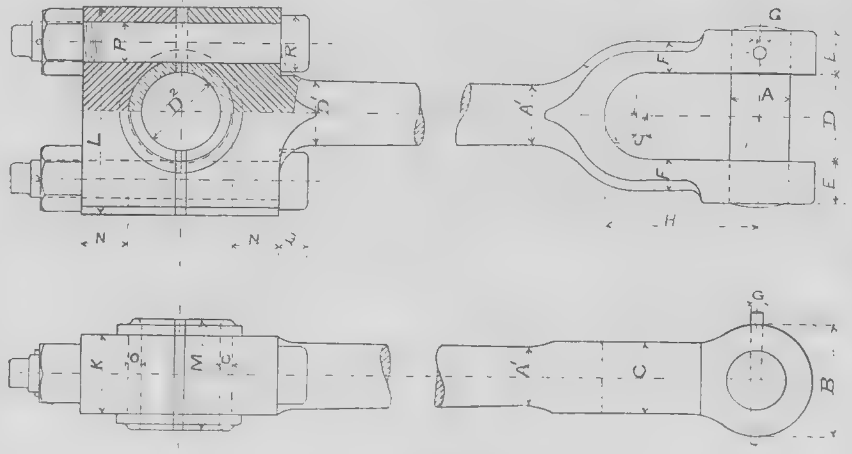


FIG. 181

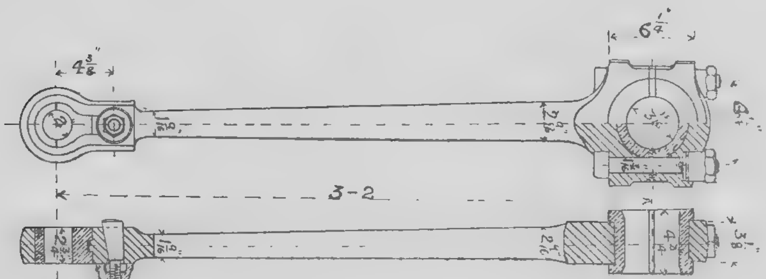


FIG. 179.

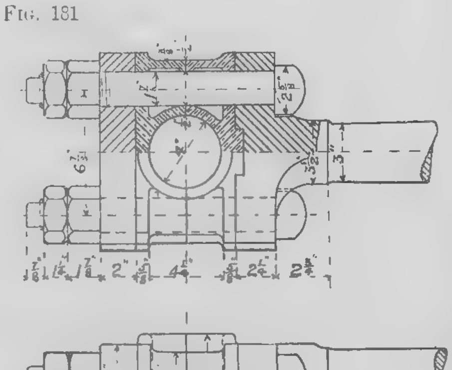


FIG. 182.

TABLE XXII.—CONNECTING ROD (MARINE TYPE).

Size of Engine Dia. × Stk.	Dia. of Piston Rod.	A = 1·08 Piston Rod.	A¹ = A.	B = 1·85 A.	C = 1·2 A.	D = 1·3 to 1·5 A.	D¹ = Area of Rod + 1/3.	D² = 1·2 A.	E = 0·7 A.	F = 0·48 A.	G = 0·2 A.	H = 2·6 A.	J	K = 1·2 D¹.	L = 2·4 to 2·8 D².	M = 1·5 D².	N = 0·6 to 0·7 D¹.	O = 0·13 D².	P = 0·7 Pstn. Rod Dia.	Q = 0·8 P.	R = 1·4 P.
in. in.	in.	in	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	n.	in.	in.	in.
12 × 24	2	2 1/4	2 1/4	4 1/4	2 3/4	3 1/2	2 1/8	2 3/4	1 1/2	1	7/16	6	3/16	3	7 3/4	4	1 3/4	7/16	1 1/2	1 1/4	2 1/16
14 × 28	2 1/4	2 1/2	2 1/2	4 5/8	3	3 3/4	2 3/4	3 1/4	1 3/4	1 1/4	1/2	6 1/2	1/4	3 1/2	8 7/8	4 3/4	2	9/16	1 5/8	1 1/4	2 1/4
16 × 36	2 3/4	3	3	5 1/2	3 5/8	4 1/2	3 1/4	3 1/2	2	1 1/2	5/8	7 1/4	3/8	3 3/4	9 7/8	5	2 1/4	11/16	1 3/4	1 1/2	2 1/2
18 × 42	3	3 1/4	3 1/4	6	4	4 7/8	3 1/2	4	2 1/4	1 5/8	11/16	8 1/4	1/2	4 1/2	10 1/2	5 3/4	2 1/2	3/4	2	1 5/8	2 3/4
20 × 48	3 1/4	3 1/2	3 1/2	6 1/2	4 1/4	5 1/4	3 3/4	4 1/2	2 1/2	1 3/4	3/4	9	1/2	4 3/4	11 3/4	6	2 3/4	3/4	2 1/4	1 5/8	3 1/4
22 × 48	3 1/2	3 3/4	3 3/4	7	4 1/2	5 1/2	4 1/8	5	2 5/8	1 7/8	3/4	9 3/4	9/16	5 1/4	13	6 3/4	2 7/8	13/16	2 3/8	1 7/8	3 3/8
24 × 48	3 3/4	4	4	7 1/2	4 3/4	6	4 3/8	5 1/2	2 3/4	1 7/8	13/16	10 1/2	5/8	5 1/2	14	7 1/4	3	13/16	2 1/2	2	3 1/2
26 × 48	4	4 1/4	4 1/4	7 7/8	5	6 1/4	4 1/2	6	3	2	7/8	11	5/8	6	15	8	3 1/8	7/8	2 3/4	2 1/8	3 7/8
28 × 54	4 1/4	4 3/4	4 3/4	8 1/2	5 1/4	6 1/2	5	6 1/2	3 1/8	2 1/8	7/8	11 1/2	11/16	6 1/2	16 1/4	8 1/4	3 1/4	7/8	2 7/8	2 1/4	4
30 × 54	4 1/2	4 7/8	4 7/8	9	5 3/4	6 3/4	5 1/4	7	3 1/4	2 1/4	15/16	12	11/16	7	17 1/4	8 1/2	3 1/2	15/16	3 1/8	2 1/2	4 3/8
32 × 54	5	5 1/2	5 1/2	10	6 1/4	7 1/2	6	7 1/2	3 1/2	2 3/8	1	12 1/2	3/4	7 1/2	17 3/4	9	3 5/8	1	3 1/2	2 3/4	5

The Absolute Zero.

WE extract the following explanation of the theory of the location of the absolute zero of temperature from a recent number of the "Locomotive":—The most accurate thermometer is the gas thermometer, in which the gas may be hydrogen, nitrogen, air, or any one of many other gases. Any one gas expands about the same as any other, when their temperatures are raised by the same amount. It is therefore not a matter of any great importance, for ordinary purposes, what gas is used in making the thermometer.

Now, if a cubic foot of hydrogen, for instance, contracts 0·0036613 of a cubic foot in cooling from 0° C. to 1° below zero, and 2 × 0·0036613 (= 0·0073226) of a cubic foot in cooling from 0° down to 2° below zero, there must be some point, if the contraction keeps on at the same rate, at which it will have contracted a whole cubic foot. Thus, in cooling from 0° down to 200° below zero, the original cubic foot contracts 200 × 0·0036613 (= 0·73226) of a cubic foot; and in cooling from 0° C. down to 273·13° below zero it will contract 273·13 × 0·0036613 (= 1·00000), or exactly a whole cubic foot. Similarly, a cubic foot of air would contract to nothing if we should cool it from 0° C. down to 272·44° below zero. Carbonic acid, in the same way, would contract to nothing if cooled from 0° C. down to 269·5° below zero.

Now, if we should construct a thermometer scale by putting the zero mark at the point which on the present centigrade scale is about 270° below the freezing point of water, no matter what size the degrees on our new scale might be, the volume of any gas, whose pressure does not change, would be proportional to its temperature on the new scale. Here, then, we have found a thermometer scale of some material service to us in making calculations; and it is to be observed that since the size of the degrees we use will make no difference, we may use centigrade degrees about as well as any other ones.

It may be shown by thermodynamics that when a gas reaches the zero point that we have been considering, it cannot expand again. It has parted with all its internal energy, and it cannot cool any further, because it no longer contains any heat. For this reason the zero we have been considering is called the absolute zero.

Now, we found above that hydrogen, air, and carbonic-acid gas, although they agreed in the main, gave slightly different results for the position of the point of absolute zero. The reasons for these differences have been investigated experimentally and mathematically by Joule and Thomson, and they will be found in the article on heat in the "Encyclopædia Britannica." We cannot enter into a full discussion of these reasons, and it must suffice to say that the corrections are necessary, because hydrogen, carbonic-acid gas and air are not what are called "perfect gases." They are very slightly viscous, and they differ from the ideal "perfect gas" in other ways, too. By a study of their properties Joule and Thomson deduced certain corrections that must be applied to the figures we obtained above. For all practical purposes we may consider the "absolute zero" to be at the point which, on the centigrade scale, is called "273° below zero." Hence, on the absolute scale the freezing point of water is 273° C. above zero; and the boiling point of water is 373° C. above zero; and the absolute temperature of anything may be found in centigrade degrees, by adding 273° to its temperature on the centigrade scale.

From the freezing to the boiling point is 100° on the centigrade scale and 180° on the Fahrenheit scale. Hence 1° C. is equal to 1·8° F., and 273° C. would be equal to 273 × 1·8 = 491·4° F. Hence, the absolute temperature of the freezing point, in Fahrenheit degrees, is 491·4°; and since the Fahrenheit zero is 32° below the freezing point, the absolute temperature of the Fahrenheit zero in Fahrenheit degrees is 491·4 − 32° = 459·4°, or say, in round numbers, 460°. Hence to convert the temperature of anything into absolute temperature in Fahrenheit degrees, we add 460° to its temperature on the Fahrenheit scale.

The facts of the case may be summarised as follows:—If a gas were cooled to a point 273° C. below the centigrade zero, or 460° F. below the Fahrenheit zero, it would lose all the energy it contains. It would have no more heat in it, and therefore it could not possibly be cooled below that point. Hence that point is called absolute zero. Furthermore, if the temperature of a gas be varied while its pressure is kept constant, the space occupied by the gas will be proportional to the absolute temperature of the gas. Thus a certain amount of air occupies, let us say, 10 cubic feet of space at 14° F., and under atmospheric pressure. If we were required to find what space it would occupy at, say, 251° F., and at the same pressure as before, we should proceed as follows: The absolute temperature corresponding to 14° F. is 14° + 460° = 474°; and the absolute temperature corresponding to 251° F. is 251° + 460° = 711°. Hence the required volume is found by the following proportion:

474 : 711 : : 10 : required volume.

Hence

$$\text{Required volume} = \frac{10 \times 711}{474} = 15 \text{ cubic feet.}$$

Many other examples of the usefulness of the "absolute zero" and the "absolute temperatures" of things will be found in treatises on heat, and in the current mechanical, engineering and scientific papers.

IT is reported from South Africa that a vein of silver yielding a high percentage of uranium has been discovered on the Witklipbank Farm belonging to the White Bank Silver Syndicate.

THE town of Wasa, in Finland, is to be lighted by electricity, the contract for the necessary plant being in the hands of the Oerlikon Company, Oerlikon, Switzerland. The plant will comprise 350 incandescent and 10 arc lamps. Electric lighting is also being very generally adopted in the town of Helsingfors.

The Transandine Railway.

THE Bureau of the American Republics has just received a minute description of the construction of the Transandine Railroad between the Argentine Republic and Chili. The railroad is divided into two sections, one extending into the Argentine Republic to Mendoza, 650 miles west of Buenos Ayres, and at an elevation of 2411ft. above the sea; and the Chilian section, which extends to Santa Rosa, 81 miles from Valparaiso, and at about the same elevation as Mendoza. The total distance by rail from Buenos Ayres to Valparaiso is about 881 miles, of which 760 are in Argentine territory and 121 in the Chilian. The road in the Argentine territory now extends as far as Punta de las Vacas, 90 miles from Mendoza, and it is expected that this section of road will be completed within the present year. During the last season 58 miles of the Argentine section from Mendoza to Uspallata were open to public traffic, and many travellers availed themselves of this overland route in preference to the long sea voyage *vid* the Straits of Magellan. For the season, which opened this month, 90 miles of the Argentine section and 20 miles of the Chilian section are available, so that only 42 miles will have to be travelled in carriages or on mules. By the present railway arrangement it is possible to leave Buenos Ayres at 9 p.m., reach Mendoza at 7-10 on the second morning, and leave Mendoza at 9 a.m., reaching Rio Blanco at 3 p.m. When the road is opened to Punta de las Vacas it will be possible to reach that point in 8 hours from Mendoza, allowing the traveller to reach Puente del Inca or Cuevas the same night. Starting early the next morning, the traveller could reach Juncal in Chili in 7 hours, say by noon, and in 10 hours more (of which 7½ would be by train and 2½ by carriage) he will be able to reach Valparaiso on the Pacific in less than 72 hours from Buenos Ayres. It is expected that after the road has been in operation for a year or two, when both sections will have reached the foot of the pass, the journey will be accomplished in about 54 hours, and at a cost of 60dols., being less than one-third of the cost of the sea voyage and a gain of 10 days in travel. The time required for completing the road has been estimated to be less than four years. Most of the delay and the slowest progress in construction is upon the Chilian side, where a great many tunnels are required.

The Statics of Launching.*

"OF the three ways in which a ship may be launched—viz., broadside on, bow on, and stern on—the latter only is investigated."

As the vessel enters the water, the centre of buoyancy, or the point through which the supporting force of the water acts, travels from the heel of the sternpost, which is first immersed to a point immediately under the centre of gravity of the ship, which last position is only attained when the vessel is afloat. A "buoyancy curve" can be drawn showing the intersection of verticals through the centres of buoyancy with corresponding water-line. This, together with a displacement curve, enables the displacement and centre of buoyancy to be readily found for any water-line. The weight of the ship acts always through the centre of gravity, which does not coincide with the centre of buoyancy, as before stated, until she is completely afloat. At intermediate positions there is a couple caused by the weight acting downwards through the centre of gravity, and the upward pressure of the water acting through the centre of buoyancy, and the leverage of the couple is given at any water-line by the distance between the intersection of the buoyancy curve with that water-line, and the vertical through the centre of gravity. The resultant of these two parallel, but unequal and opposite forces, will be a force equal to the difference between them acting through a point on the opposite or forward side of the centre of gravity, and at such a distance from it that its moment is equal to the moment of the buoyancy about the centre of gravity, and a "curve of resultants" can be drawn passing through the intersections of the water-lines, with the lines of action of the resultants.

Directions are given for constructing this curve, the origin of which is at the intersection of the water-line passing through the lowest point of the ship with the vertical passing through the centre of gravity, and which has the flotation line as its asymptote. From the "curve of resultants," the pressure on the ways and the line of its action can be readily determined for any water-line. As the ship descends, the water-line rises, the "resultant" becomes smaller, and its line of action moves forward. So long as this remains aft of the forward poppet-lashing, or most forward part of the cradle, the ship will maintain her inclination unaffected, but if it pass forward of the poppet-lashing the ship pivots about its forward support, the stern lifting, and the whole pressure due to the resultant is then concentrated at the poppet-lashing. The ways, poppet-lashing, and ship must be strong enough to resist this pivot pressure, and its value should always be ascertained.

The author shows how to determine the length of ways necessary to prevent "stumbling" or "tripping." The former occurs when the resultant pressure at any water-line falls beyond the end of the ways. There being then no equal and opposing force, the ship's stern falls, and as she continues to move onward she scrapes against the end of the ways, until the displacement of the after body increases sufficiently to raise the stern and cause the fore body to strike the ways again. This stumbling often occurs; it is dangerous, and frequently results in serious damage to the ship; in shallow water the stern may strike the bottom, and the launch be a vexatious and costly failure. With a ship whose pivoting point is some distance aft of the forefoot, another danger may be feared if the ways are so short that the resultant pressure falls beyond them after she has commenced to pivot, but before the ship has floated, the forefoot falls striking or scraping the foot of the ways. For a safe launch it is therefore necessary that the ways should be of such ample length that the line of action of the resultant downward pressure shall always fall upon them, and that the pivot shall be supported by them until the ship floats.

The curve of resultants can be accurately drawn, and the pivot pressure and length of ways determined when the following are known:—

1. The ship's displacement curve.
2. The ship's buoyancy curve.
3. The angle of inclination of the ways.
4. The position of the ship on the ways.
5. The position of the pivot.
6. The weight of the ship.
7. The position of the centre of gravity.
8. The water-level at the moment of launching.

The first five are known months before the ship is launched, but about the remaining three there is more or less uncertainty at the time the calculations are made. It is therefore necessary to assume limits within which they will certainly fall, and allow for the most favourable condition. It will be found that for any given position of the ship's centre of gravity the length of underwater ways required will increase when the ship's weight is increased, and for any given weight of ship they will increase when the ship's centre of gravity is moved aft. A less weight of ship with its centre of gravity farther aft usually requires a greater length of underwater ways than a greater weight whose centre of gravity is farther forward.

It is therefore sometimes advantageous to place weights in the bow in order to move the centre of gravity forward. Another method of shortening the length of underwater ways is to increase the volume of the after body by securing camels, empty barrels, or cork under the counter.

The distance of the line of ways above or below any given point on the ship's side, as the heel of the sternpost, is determined by practical considerations, and does not affect their length.

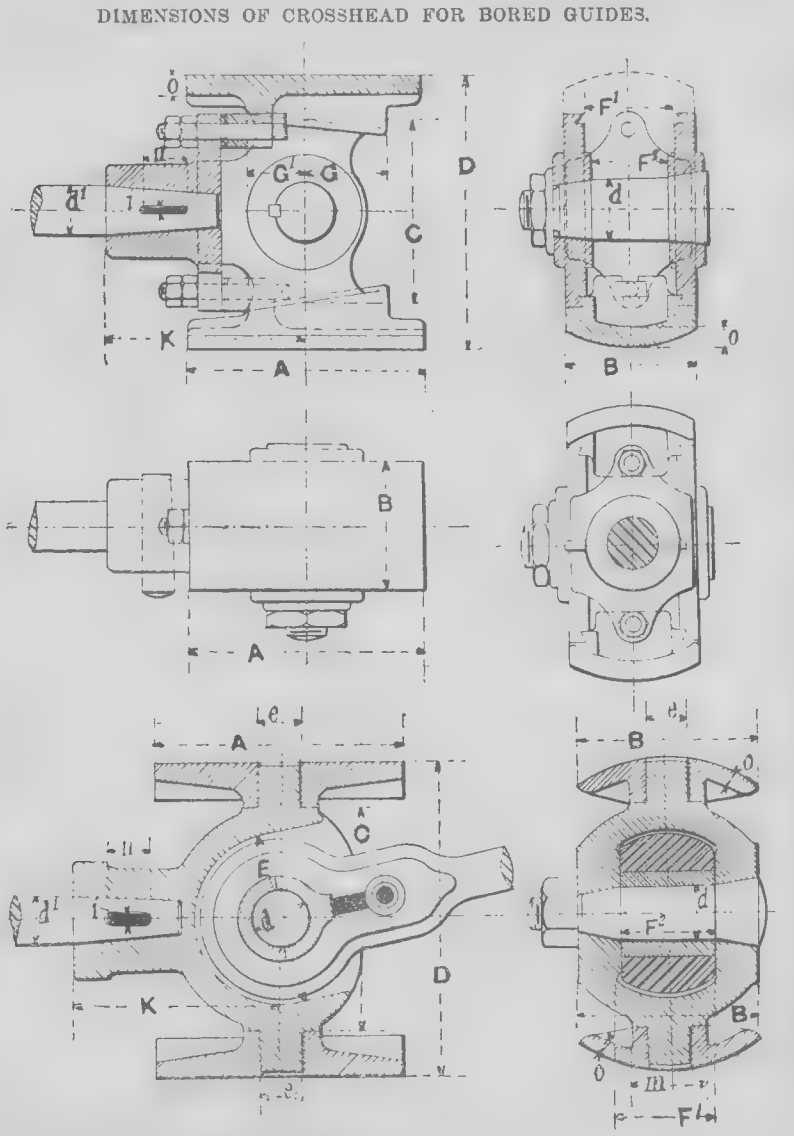
As a slight fall in water-level requires a considerable increase in length of ways, provision should be made for a fall such as occurs during the first hour after high water.

The greater the difference between the inclination of the keel blocks, and the inclination of the keel after launching, the greater is the pivot pressure. It is advisable to have this difference as small as practical consideration will permit, and as ships generally draw more water aft than forward they are for this reason usually launched stern on.

*Inst. C.E.: Foreign Abstracts.

An Engineer's Notes.

DIMENSIONS OF CROSSHEAD FOR BORED GUIDES.



D	A	B	C	E	F_1	F_2	G	G_1	K	d	d_1	e	m	n	o	t
6	6	2¾	4¾	4¼	2	1⅞	2	1⅝	3⅝	1⅜	1	1⅜	2⅜	1⅛	⅝	¼
7	6¾	3¼	5	4¼	2	1⅝	2¼	1⅜	4⅛	1⅜	1	1⅜	2⅜	1⅛	⅝	¼
8	7⅝	3⅝	5½	4⅝	2¼	2⅛	2⅝	2	5	1½	1 3/16	1⅝	2 3/16	1⅜	⅝	⅜
9	8⅜	4⅛	6⅛	5⅛	2½	2⅜	2⅞	2¼	5½	1¾	1⅜	1 9/16	3/16	1½	⅝	⅜
10	9⅛	4⅝	7	6	3⅛	2⅝	3¼	2½	6¾	2	1 9/16	1 11/16	3 7/16	1⅝	⅝	⅜
11	10	5⅛	7⅝	6⅝	3⅝	3	3½	2⅝	7	2 1/16	1 11/16	1 13/16	3 9/16	1 11/16	1	⅜
12	11	5⅝	9⅛	7⅛	3⅝	3⅛	3¾	2⅞	7½	2⅜	1⅞	1⅞	4	1 13/16	1 1/16	⅜
14	12¼	6⅜	10	7¾	4	3½	4	3	9½	2⅝	2 1/16	2	4	2	1 1/16	⅜
16	14¼	6¾	12	9	4½	4	4⅞	3⅝	11½	2⅞	2 5/16	2 1/16	4⅜	2	1	⅜

The Chemical Examination of Boiler Feed Water.—I.

[CONTRIBUTED.]

THE value of a water for boiler purposes depends upon its freedom from incrustating materials, usually the carbonates of calcium and magnesium ($CaCO_3$, $MgCO_3$), and sulphate of calcium ($CaSO_4$), and from other constituents, which, although not scale-forming, may have an injurious effect on the boiler. Chloride of magnesium ($MgCl_2$) belongs to this latter class, since at the temperature of boiling water—212° F.—it is decomposed with the formation of hydrochloric acid, which, as is well known, has a corrosive action upon the plates of the boiler.

Although the suitability or otherwise of a water for feeding purposes depends to a great extent upon the amount of solid matter present, it is really upon the nature, and not the amount, of the matter that the decision for or against is based. A water may contain a somewhat large amount of solid matter in solution, and yet be well adapted for boiler purposes. For instance, a water containing, say, 50 grains per gallon of matter consisting of the chloride or carbonate of sodium, may be used without any ill effect, provided that in working the precaution is taken to frequently use the blow-off; while a water containing half, or even less, of this amount of solids consisting of the sulphate of calcium, would be totally unsuitable for boiler feeding.

Frequently at the first glance the amount of matter in solution seems too small to justify the condemning of a water. Upon going into figures, however, this is soon explained. For instance, 20 grains per gallon of solid matter does not appear a very large amount, but such a water would, in a week of 60 hours, assuming evaporation to take place at the rate of 350 gallons per hour, deposit ¼cwt. of matter; and taking the specific gravity of the matter as 3, this amount will be sufficient to cover 250sq. ft. of boiler plate with a thickness of 0·0144in., which, if allowed to accumulate, would in three months amount to ⅛in.

In determining the suitability of water for boiler purposes, it is usual to estimate the solid matter in suspension, solid matter in solution, chlorides, sulphates, hardness, and to make an analysis of the solid residue. No hard and fast rule can be laid down as to the volumes of the water to be taken for the determination of the several constituents. Much depends upon the nature of the water, a "soft" water necessitating the employment of larger volumes than a "hard" water; the operator must therefore use his judgment. The volumes here given will, however, in most cases be found suitable.

As regards the results of the analysis, they may be returned either in parts per million, parts per hundred thousand, or in grains per gallon. In this article the latter plan is followed.

The Sample.—It is hardly necessary to point out that it is of the utmost importance that the sample submitted to analysis be a fair representative of the water supply.

Winchester quart bottles, holding about 2½ litres, are very convenient vessels for collecting and storing the samples in. For an ordinary analysis, two of these bottles filled will suffice; but when an elaborate examination is to be made, double, or even treble, this quantity should be taken.

In collecting the water from a pump or tap, allow a few gallons to run to waste before taking the sample. If the water is to be sampled from a well, tank, or river, immerse the bottles beneath the surface of the water, exercising great care not to disturb any mud and sediment, and to prevent any scum finding its way into the bottle. In every case fill the bottle with the water, empty out, and repeat this operation two or three times. Finally, fill the bottle to within half-an-inch of the stopper, insert the stopper, and tie down with string.

The general appearance of the water should be noted, and its action upon blue and red litmus papers determined as follows:—Take pieces of blue and red litmus papers, and on to each bring, by means of a glass rod, a drop of the water. If, after standing for some time, a blue spot appears on the red paper at the point of contact, the water is alkaline; if a red spot appears on the blue paper, the sample is acid (carbonic acid turns blue litmus paper red; sufficient time, therefore, must be given for the expelling of this acid). If no alteration occurs in the colours of the papers, the water is neutral.

Matter in Suspension.—As a rule, unless the water is distinctly turbid, the analysis is made on the unfiltered water. When, however, the amount of matter in suspension is appreciable, the water is filtered

previous to being submitted to analysis. The amount of matter in solution is determined as follows:—

Through an ashless filter paper of about 1in. diameter, pass from three to four litres of distilled water, and then remove the filter paper from the funnel holder; dry in the water oven at 212° F.; allow to cool under the desiccator, and carefully determine the weight. Replace the filter paper in the funnel holder, and through it pass a measured quantity, say 2 litres, of the water under examination (the bottle containing the water should be well shaken before measuring out the quantity for analysis), receiving the filtrate in a clean dry Winchester bottle. When the whole of the measured quantity has been passed through the filter, remove the funnel holder from the Winchester bottle, and wash out the measuring flask with distilled water, passing the washings on to the filter, and subsequently wash the filter paper and contents with distilled water. Now remove the filter paper from the funnel holder, place in the water oven to dry, allow to cool under the desiccator, and reweigh. The increase in weight of the filter paper corresponds to the amount of the total solid matter in suspension in one litre of the water, which, multiplied by 70, will give the total matter in suspension in grains per gallon.

Having thus determined the total matter in suspension, place the filter paper and contents in a tared porcelain or platinum crucible, ignite at a low red heat, allow to cool, and reweigh. The weight thus found gives the mineral matter in suspension in one litre of the water, which calculate into grains per gallon, as above. The difference between this amount and the total amount present will, as is evident, give the organic matter in suspension. When it is necessary to perform the analysis on the filtered water, pass a couple of litres through a dry filter, and preserve the filtrate in a stoppered Winchester, from which the several volumes are taken as required.

(*To be continued.*)

Shipbuilding Notes.

On the 6th inst Messrs Irvine and Co., West Hartlepool, launched a steel screw steamer of about 4450 tons deadweight carrying capacity. The vessel's dimensions are:—314ft. by 40ft. 6in. by 23ft. 10in. Engines of the triple-expansion type are being supplied by Messrs. Thos. Richardson and Sons.

On the 7th inst. Messrs. Craig Taylor and Co. launched from their Thornaby shipbuilding yard, Thornaby-on-Tees, a steel screw steamer of the following dimensions:—309ft. by 40ft. by 22ft. depth (moulded). The triple-expansion engines are being constructed by Messrs. Westgarth, English and Co., Middlesbrough, and have cylinders 22in., 35in., and 57in. diameter, by 39in. stroke.

There was launched from the works of Messrs Hawthorns and Co., Leith, on the 6th inst., a twin-screw steamer, built to the order of the Kurrachee Port Trust, and intended for service on the Indian coast. The dimensions are:—Length B.P., 125ft.; breadth moulded, 24ft.; depth moulded, 12ft. She will be fitted by her builders with two sets of compound surface condensing engines, having cylinders 20in. and 40in. diameter, by 24in. stroke, working at a pressure of 100lb. per square inch.

The trial trip of the screw steamer "Carl Hecksher" took place on the 23rd ult., from Elsinore, in the Sound. The vessel's dimensions are:—260ft. by 36ft. by 17ft. hold. Her carrying capacity will be 2300 tons on 18ft. 5in. mean draught. The engines, which are of the triple-expansion type with surface condenser, have cylinders 19½in., 31½in., 51½in. by 36in. stroke, and will indicate 650I.H.P. average work at sea. They are supplied with steam from two single-ended multitubular boilers of 150lb. pressure. During a run over the measured mile a speed of 10·4 knots was attained.

Messrs. Wood, Skinner and Co. launched, on the 7th inst., from their shipyard, Bill Quay, a steel screw steamer, built to the order of Messrs. Martin and Blairs, Newcastle, of the following dimensions:—Length, 283ft.; beam, 37ft. 6in.; depth (moulded), 20ft. 8in.; designed to carry 3100 tons deadweight. The engines, which are of the triple-expansion type, will be fitted by the North-Eastern Marine Engineering Company Limited, Wallsend, the diameter of the cylinders being as follows:—20in., 32½in., and 54in., by 36in. stroke.

On the 6th inst. there was launched from the No. 1 Cleveland dockyard of Sir Raylton Dixon and Co., a steel screw steamer, which has been built to the order of Messrs. Farrar, Groves and Co., of London. The principals dimensions are:—Length over all, 327ft 9in. by 41ft. beam by 24ft. depth (moulded), and the vessel will have a carrying capacity of about 4500 tons. Engines will be fitted by the North-Eastern Marine Engineering Company Limited, of Sunderland, the cylinders being 23in., 38in., and 62in. diameter, by 42in. stroke.

Failures in the Necks of Chilled Iron Rolls.*

During the last thirty years great improvements have been effected in the machinery for rolling heavy iron and steel plates, which has reduced the cost of production and enabled us to compete successfully with foreign makers, where the labour is less costly than ours. The ponderous gearing which at one time occupied so much space, and was a source of great expense, has given way to direct driving. Three high rolls and hydraulic tables have been introduced; in fact, our modern rolling mill is different in every way to that of the past, with the exception of the chilled iron rolls, which have to do all the work. These seem to have had very little attention generally, and the cause of any failure has been put down to inferior material, which in many cases may be true. Steel rolls have been adopted in place of grey iron for cogging, and also in large plate mills, where finish and accuracy are not so important as safety, but where a good face and accurate gauge are required, chilled iron stands firm against all attempts to displace it. It is not my intention, however, here to enter into the qualifications of the material, or its chemical properties, but as briefly as possible to consider a few details in connection with the design of rolls, and to set before you certain facts that have come under my notice during the last twenty years as a roll-maker. Having had the privilege of inspecting many works on the Continent, as well as in England, Scotland, and Wales, and noting the different methods employed by various engineers and millowners in the manufacture of iron and steel, as well as the various proportions and designs of the chilled iron rolls employed in the manufacture of plates and sheets; having noted, also, the immense loss incurred in breakages, which may to a very large extent be prevented, it occurred to me that a few words upon the subject would not be out of place here, and might provoke a discussion which would be of benefit to the members of this institute.

Many methods have been tried to improve the working qualities of the rolls, and there is still very much to be accomplished; but the only real improvement that has yet been successfully carried into effect is that of keeping the rolls cool by a copious supply of tepid water, without which it would be impossible to prevent disaster owing to the quick succession of hot blooms, which is nearly equal to the effect of a furnace. When we consider that the output for one pair of rolls was formerly only about 150 tons per week, and now is from 900 to 1000 tons, it is obvious that some provision must be made to accomplish the extra work. In many sheet mills, indeed, there are no means whereby the temperature may be kept down in the body of the roll, which rises to that of oxidation; but although the cooling of the body is not attempted, a good supply of water is often provided to keep the necks as cool as possible, so that the lubricant may not burn off, or the brasses cut. The consequence is that an unequal expansion takes place in the body and the neck, and though the effect does not show itself at once, yet a weakening process has been set up which will eventually shorten the life of the roll, for a failure is certain sooner or later to take place, if not provided against by a suitable design. By careful consideration the temperature of the roll may be gradually reduced, so that the atoms of the iron at the junction of the body and neck of the roll are not subjected to a disturbing or disorganising influence.

Some years ago my attention was drawn to certain difficulties in connection with the chilled rolls used in the tinplate trade in South Wales, and what made the matter difficult to solve was the fact that while most of our friends down there were well satisfied with the rolls in every way, a few were a source of great trouble. Now the material of which the rolls were made was identical in each case, and the work they had to do was in all cases the same, but the results were extremely variable. Having suspicions that the fault lay in the design, drawings were prepared of all rolls sent into that district, which showed that those which were satisfactory were different in design to those that failed during their work, and the appearance of the fracture in the broken roll clearly showed the temperature of the neck and the roll to have been quite different. The metal of the body had turned a dark-blue colour owing to oxidation, and the fracture of the neck had remained perfectly bright, having, however, a ragged appearance, the metal in many cases hanging away from the face of the fracture as though torn away by great force.

* Paper by Mr. Winder, read at the autumn meeting of the Iron and Steel Institute.

Now it is worthy of note that all chilled rolls used in this branch of trade for hot rolling require to have an abnormally large diameter of neck; for instance, a roll having a diameter of 19in. is never safe unless it has a neck of 14in. diameter; but a similar roll for cold rolling is perfectly safe with a neck having a diameter of only 12in.—in fact, a breakage has not at any time been reported to me; yet the pressure upon the bearings is considered to be equal in both cases, so that the only conclusion one can draw is that the weakness has been caused in the hot roll by the unequal expansion of the body and the neck.

A very interesting visit was made to a tinplate works some time ago, where the rolls were certainly designed with some degree of care and judgment, and from inquiries made, the result was quite equal to expectations. In this case the necks were much under the usual proportion for tinplate hot rolls, and the diameter of the body about the same; notwithstanding which, broken necks are almost unknown in this mill. About the same time similar visits were made to other tinplate works, where the rolls were made otherwise, and much valuable property was found lying on the scrap heap. Now, had these rolls been made by some inexperienced iron-founder, it might not have been so significant, but an examination of the names upon the tennons showed that they had been manufactured by various makers who have the reputation for doing good work. Other visits were made to ironworks in a different district, and the same results were shown, but in a much larger degree, as the rolls were some six or seven times the weight, and, as in the case of the tinplate rolls, the fracture was precisely the same. Some time ago a report was given in one of the iron-trade journals of a bankruptcy case, near Birmingham, when the bankrupt stated one of the causes of his failure to have been loss by broken rolls, and gave an estimate of £2600 for that item. Being unaware of the nature of the breakages, and having had nothing to do with this particular house, I can only conclude that there must have been want of care somewhere.

An application was made to me some few years ago to supply a set of three grain rolls for cogging down billets for wire rods. It was pointed out by my friends that they had tried many roll makers, but the result was always the same, and the neck at the leading gate end always came off after a certain period of work. It is not, therefore, surprising that a similar result happened in my own case. At the time, the actual cause appeared to be unaccountable, but the experience that has been gained since then convinces me that the failure was entirely due to the unequal expansion of the neck and body, for the leading gate was very close to the end of the roll (a mistake that is often made), thereby causing the end of the roll to be greatly heated near the junction of the neck, which was kept cool by means of a copious supply of cold water.

Another interesting case occurred about the same time, when the diameter of the necks of a pair of chilled rolls was reduced to save power, the area of the bearings was maintained, and the result up to a certain time was so satisfactory that the proprietor of the mill decided to adopt the smaller necks in the future, thinking he had given the rolls a fair trial after having run them about a month or five weeks. It was found, however, that we had been a little hasty in drawing our conclusions, and our plans were seriously interrupted by the necks breaking off. On examination the fracture displayed a dark ring, which subsequent experience proved to be the result of an unequal expansion of the body and the neck, although at first it was put down to a faulty casting, having that appearance. Had it been so, however, a failure would have taken place much earlier. Evidently a rupture was set up on the periphery of the neck, and by frequent heating and cooling the molecular construction was disturbed, which caused the fracture to travel towards the centre, until the remaining portion became too small to resist the work put upon it. It is a source of regret that, owing to the death of the owner of the mill, the new design was never tried.

Continental millowners do not appear to suffer from the failure of roll necks so much as some of our mills at home; but there are two good reasons to account for that fact. The first is, they adopt a modified design of roll; and the second, it may be that we in England make our rolls do much more work than they do on the Continent. This, indeed, is very probable. In the event of a breakage of a roll, the radii and diameter of necks are often looked upon as the sole cause of mischief, and consequently they are in many cases increased to meet the required need. Trouble of this kind has been overcome by these means; but it appears to me that it is a very unscientific mode of procedure, and that bringing the neck up towards the diameter of the body is assisting to bring about another evil, and conducting the heat to a place where it is not wanted, the longitudinal cracks upon the face of the necks being evidence of over-heating; it also considerably increases the friction, particularly if the necks burn off the lubricant. Larger radii, without increasing the diameter of the neck, are not so serious, and reduce the diameter and temperature gradually, thereby allowing the neck to be kept cool without the fear of causing a movement of the molecules of the iron at the junction of the neck and body. This really is the duty performed by the large radii. Although it is by some used only as an extended area to give greater strength to resist the pressure upon the necks during the time the rolls are at work, yet it appears to be unnecessary, and productive only of evil. Of course, in estimating the breaking strains of the rolls, we must take into consideration the torsional strain, and the resistance offered by the steel or other material that is being rolled as well; but as there are no data in my possession to work upon, probably the members present, many of whom are in daily contact with the work, may assist me. Very much of course depends upon the material, the temperature, and the draft; but it appears to me that the necessary pressure required to reduce steel at the heat at which it is usually worked is much below that of the breaking strains of the roll. I have prepared a design for a chilled-plate roll, which has been reduced at the end of the barrel so that the temperature may not be so great at the junction of the neck and body, the roll having comparatively small radii; it has also a set-off at the end of the neck to which the tennon is attached, so that the strain in cooling in the sand is not so great as it otherwise would be when the two parts of the casting are so disproportionate.

Before closing my paper, and in order to substantiate my views upon this question, let me ask you to consider that the failure of the necks of chilled-plate rolls often takes place after a considerable period of working, only sometimes they occur soon after being put to work; but as the failure in those cases is attributable to some specific cause other than that which we have before us, we must leave it out of our consideration. Taking the generality of rolls which may have worked two, three, or more months, the fact that they have worked so long sufficiently proves that they are strong enough to resist the strains put upon them in the process of rolling, so long as the molecular construction of the metal at the junction of the neck and body is not disturbed; but at every heating and cooling, and also during the time they are at tension, as is the case in an unequal expansion, every vibration of the mill is assisting, though in a very slight degree, to cause a rupture which must eventually end in the failure of the roll neck and serious loss to all concerned.

A Few Practical Observations on Covered Wire Making and Using.†

A great deal has been said and written about "hay scales wire," and so few have been found to say a good word for this "weatherproof" wire, of which most of our pole lines are constructed, that the unfortunate superintendent whose company will not allow him to expend the money for a taped and braided rubber insulation feels ashamed of what he has done, and answers under his breath "weatherproof" when asked about his out-of-door insulation.

Are we, then, really so remiss in our regard for public safety in this country, and have we really no engineers brave enough to stand out for first-class construction in our central-station installations? Across the water this opinion seems to prevail, and who can wonder when the men using such construction are so ready to acknowledge an inferiority in comparison with European work. In one case I know of, an American at a foreign exposition in charge of a telephonic exhibit, which was surmounted by a great red-cross arm, green glass insulator, pole, etc., would tell all comers that it was intended as an illustration of our beautiful climate which would allow such poor construction. I do not think that such strictures on our engineering abilities in this country are justifiable, or that the exceptions to our methods of construction

† By Frederic A. C. Perrine, in the "Electrical Engineer" of New York.

are well taken. Rather it is one of those cases where the witless general average has drawn a better conclusion than the long-headed individual; or, better, it is a case in which a certain few well-informed engineers have taken the lead and been followed by the mass of constructors without the latter understanding the reason for their perfectly rational action.

I do not wish to be understood as advocating any work being done in an imperfect manner, nor do I wish to claim that waterproof wire has as high an insulation resistance as a high-grade rubber. But I do not consider that the unattainable perfect is engineering in its true sense; on the contrary, I hold that the engineer should, with such means as are at his disposal, attain the best possible results as regards efficiency of plant, public safety, and dividend payment by his company; and I do not consider that high insulation is the only consideration in all electrical installations. Taking the latter point first, let us consider what are these wires which are called by the trade weatherproof, and taped and braided rubber, or, as they have been nicknamed, "hay scales wire," and the "ites and shaws wire."

In the "ites and the shaws," our rubber manufacturers, with the aid of the electricians, have devoted their best energies, some to produce the most lasting insulation mechanically, some to produce the highest insulation resistance, and others to turn out the cheapest wire, and have used about every available compound of rubber and its substitutes. Except the last, of producing a cheap wire, these problems have been found to be very baffling, and although there are many different brands of rubber wire on the market, it is hardly possible to secure one which in the sun, the wind, and the rain will maintain either its electrical or mechanical qualities. A reason that this should be, may perhaps be known to that fortunate man who thoroughly understands the nature and cause of "blooming" in rubber goods. To be sure, this failure is not so complete that the insulation falls from the wire or that the galvanometer will show expensive leaks along the pole line, but it is serious enough to make the high insulation of a rubber-wire line delusive, and to render contact with the wire possibly dangerous, if carrying high potentials in wet weather. Whilst as to the cheap shoddy rubbers which are sometimes used, and which make a very handsome wire to sell, as good and safe an insulation could be obtained by surrounding the wire with sponge. Turning now to our "weatherproof wire," what is it? How should it be manufactured? And by what qualities is it suitable for pole lines?

A few years after the introduction of "underwriters'" wire, which was intended to fill the rules of the New York Board of Fire Underwriters for 1892, it was recognised that although an excellent insulation in dry buildings, it could not be relied upon in any way for out-of-door construction, and Mr. A. A. Knudson devised for Holmes, Booth and Haydens a compound having more waterproof qualities and intended to be applied to a braided wire, as the underwriters had required. This compound of paraffin, cresine, and asphaltum was a decided advance, but was actually a long way behind the compounds used in the same manner and bearing the same names which are at present in use.

Almost every manufacturer has to-day a slightly different compound and different means of applying it, and not a few neglect the essential features of their product in order to obtain a handsome appearance, and, consequently, easy sales to uninstructed purchasers. For the best results the insulating compound should be one which is applied to the wire after it has been rendered thoroughly liquid by heat, and which, when so applied, is not softened as much as to run when subjected in the open air to the warmth of the summer's sun, and which will not crack and open by swaying to the wind under the influence of frosts. The component parts should make with each other a true compound, and not merely a mechanical mixture capable of being separated by the filtering action of the capillary fibres of the yarn. The yarn itself should be considered as a carrier and protector of the compound, and, for this reason, so proportioned as to be a minimum except in the outside braiding, where the strength is needed for protection against mechanical abrasion. To manufacture such a wire as is described above is far more difficult than may be at first apparent, and the best results are often obtained in a product which has less the appearance of so doing than a more faulty wire. Perhaps the handsomest external appearance can be obtained by the application to a wire braided dry with a black dyed yarn of a well-made compound dissolved in bisulphide of carbon or coal-tar naphtha; but although almost perfect in appearance, such a wire has almost all the undesirable elements. The yarn which has been applied to the wire in a dry state will always lie closely to its surface, and by its powerful capillary attraction will make a good contact communicating with the surface of the insulation from the conductor wherever the least moisture is absorbed; and the compound itself on delivering up its solvent maintains a slight porosity to aid in such an absorption, while the dye on the yarn fills the pores and renders it less capable of absorbing the heavy insulating compound, as well as offering little resistance to the absorption of water. On the other hand, if the wire is passed through a hot compound of very liquid and rather soft nature, and immediately into the braiding machines, where a single braid of a soft yarn is put on, and then again through the same insulation, and a couple of braids (one soft and open and the finishing braid close and hard), and is then again passed through a harder compound, capable of being rubbed down into the crevices between the yarns, leaving a smooth surface for finish, the essential features for a serviceable weatherproof wire are obtained.

With this method of manufacture it is impossible to make a wire which is perfectly uniform in every foot, or even, for that matter, in every mile, so that the practice of selling by the foot, which is perfectly satisfactory to both purchaser and manufacturer in the case of a rubber covering, is obviously unfair to both in this weatherproof; while the very cheapening of the product by increase of the insulation compound in proportion to the cotton yarn enhances the value of the covering as an insulation. However perfectly manufactured, this wire is not and cannot be said to be insulated against a compound immersion in water, for the reason that no compound so saturates the fibres of a yarn as to altogether exclude a further absorption of water, and the only value of an immersion test is a comparative one of the rapidity with which the different grades will absorb water and fall to some arbitrarily determined low limit of insulation resistance. This being the case, weatherproof wire should not be used where it is not capable of continued inspection by the eye. For concealed work, whether done between floors or cleats or porcelain insulators, or for wires embedded in plaster, it is obviously unsuited, while even for tube work there is continually present a certain amount of risk, although these tubes, if properly installed, should be watertight and sealed, and its use under such conditions is not necessarily dangerous.

On a pole line, however, this wire is not satisfactory, but for many reasons is the best possible, provided only it is chosen for care and correct principles in its manufacture, and not simply for the external appearance. The external service of a hard yarn and polished compound is not only a protective against destruction through abrasion, but also leaves no projecting irregularities for the accumulation of rime and the lodgment of moisture. Internally the softness of the compound of itself repairs any minute cracks which may be made when stringing the wire in cold weather, and as time goes on it saturates more and more thoroughly the yarn which thus holds it in position, while its known nature will guard against the careless handling of live wires by the workmen—though accidental contact is not by any means attended by disastrous consequences. It is in view of these qualities of weatherproof wire that it has been so universally adopted in this country, and by our best engineers. By allowing satisfactory construction at a moderate expenditure of capital, it has extended the privileges of the electric light universally throughout our country, while the more cautious but not more careful practice abroad has restricted the light to the largest and most wealthy centres of population.

The Decay of Mechanical Skill.

A WRITER in the "Engineering Magazine" (N.Y.) makes the following remarks in the course of an interesting article, "Are Modern Mechanics Deficient in Skill?":—The decay of mechanical skill, which is the direct result of modern shop methods and the universal adoption of machine tools and labour-saving machines, is as apparent as the collateral fact of the decay of artistic sense in workmen resulting from the gradual substitution of machine-work for hand-work. The writer recently needed some sheet-metal work done in accordance with drawings prepared by him. Forty years ago there could have been found in any American village of 2000 population a tinshop wherein this job would have been done at once, and well done. After a long search a good general worker of sheet metals was found who was willing to undertake the job; he was not found in a sheet-metal-working establishment, but in a shop where model machinery is a specialty. Such shops as these pull out from numerous applicants such as can demonstrate all-round skill in their respective trades. They are usually men well advanced in life. As they drop away, one after another, it becomes more and more difficult to supply their places. The decrease of manual skill and of artistic sense among mechanical workmen results not merely from want of such all-round practice as they got half-a-century ago, but from a want of that sort of loving interest in their work the old-timers used to feel when they could put something of their individuality into everything they made. Nowadays the workman has simply to work out a design—or rather, to run a machine to work out some part of the design—prepared by some artist whom he does not know and never has seen. The general result may be beautiful when the different parts are assembled, but the workman feels that he has no personal share in the production of its beauty. He has become a regulator of a machine; he simply sharpens tools, adjusts them, keeps his machine oiled, and puts into it the material to be worked upon. All the precision, the nicety of operation, are due to the inanimate rather than the living tool. What interest can such work beget? What lofty ambition can it stimulate? What workman when the bell rings the time to quit work feels reluctant to leave his task or lingers over it to bring out some beautiful effect or interesting combination that he feels he must see before he can depart contentedly?

Notices of New Books.

THE ENGINEERING TELEGRAPHIC CODE. By A. H. BLACKBURN and JAMES STEVENS. London: 9, Fenchurch-avenue, E.C. 40s.

CONSIDERING that within the last few years telegraphic codes have become an absolute necessity in almost every class of foreign business, it is scarcely surprising to find that a desire is now evinced by certain sections of traders in this country for a special code applicable to their particular requirements. So far as the engineering community is concerned, their wants are completely met by the work under notice, which has been specially compiled for use in all general business connected with engineering plant, machinery, and accessories. The code words have been selected by the code expert, Dr. Ager, to comply with the Telegraph Convention rules, and also to obviate confusion with the code words of the public codes in general use. The code may, therefore, be employed in conjunction with any of the public codes now in use without the least possibility of confusion or misunderstanding. Over 30,000 phrases are contained in the work, and these are arranged alphabetically according to the principal word in each phrase, general sentences forming one part, while another gives code words, numerals, dimensions, etc.; there is another section to be used in conjunction with these, and dealing with general plant, accessories, etc.; while a fourth part gives a list of makers. The work, which is neatly printed and bound, appears well adapted to its purpose.

THE LOCOMOTIVE ENGINE AND ITS DEVELOPMENT. By CLEMENT E. STRETTON, C.E. London: Crosby Lockwood.

MR. STRETTON'S contributions on the history of the locomotive and kindred subjects, which are well known to many of our readers, are embodied in the work under notice, together with much additional matter which cannot fail to interest those connected in any way with railway engineering, while to the lay reader it should also prove attractive. We must say, however, that we think Mr. Stretton is somewhat too dogmatic in awarding credit for the various inventions connected with the locomotive. For example, although the balance of evidence seems to favour the assumption that Howe was the inventor of the link motion, the point is still a disputable one. Mr. Stretton has certainly produced a readable little book, exceedingly interesting, as we have said, but of limited value as a technical contribution on the subject. A large number of illustrations are given, chiefly of old locomotives.

Trade Notes.

Messrs. Crompton and Co., of London, have successfully completed the electric lighting of the city of Pretoria, South Africa.

Messrs. P. and W. MacLellan, engineers, Glasgow, have just completed the erection of a bridge near Linlithgow. It has a span of 50ft.

Messrs. Siemens and Halske, of Berlin, have secured the contract for the erection of a central station in Wesselburen, Germany.

The authorities of the Baden State Railways are inviting tenders until the 7th of November for the supply of sixteen express locomotives.

The Britannia Mills, Princep-street, Birmingham, were offered for sale by auction on the 4th inst., and were purchased by Alderman Cook for £4030.

The Kelliebank Iron Shipbuilding Yard, Alloa, has been practically closed, owing to dulness of trade. It is expected that this will only be temporary.

Messrs. Mather and Platt Limited, Salford Ironworks, are constructing an electric travelling crane, for use at the central electric-light station in Manchester.

Messrs. Easton and Anderson, of London, have secured the contract for a large quantity of iron, to be used in the extension of an iron shipping pier at Huelva, Spain.

The Ebbw Vale Steel, Iron, and Coal Company have received an order from the Great Northern Railway of the Transvaal for 30,000 to 40,000 tons of steel rails and fishplates.

Messrs. Lindsay, Burnet and Co., engineers, Govan, have completed the delivery and erection of the steam generating plant for the electric lighting of the city of Glasgow.

The Beaver Ironworks, Wolverhampton, were restarted last week, after standing idle since the end of last year. Messrs. Isaac Jenks and Sons intend manufacturing sheet and hoop iron.

The Brush Electrical Engineering Company have secured an order for the supply of the alternate current generating plant and transformers for the [illegible] electric-lighting station.

Messrs. Westwoods and Wright, of Brierley Hill, Staffordshire, have been awarded the contract for the [illegible] roof at the gasworks, Manchester.

Messrs. E. Morewood and Co., South Wales Works, Llanelly, have just completed [illegible] use in their new works in the United States.

Messrs. D. and Y. Stewart and Clydesdale Company Limited, Glasgow, have secured an order for hydraulic hydrants for the Dundee Harbour Board. The same company are also to supply the condenser pipes for the hydraulic machinery.

Messrs Baird, Thompson and Co., ventilating engineers, of Glasgow and London, have contracted with a large Atlantic steamship company to fit up the company's fleet of steamers with their system of mechanical and automatic ventilation.

Messrs. Walter Scott and Co., Newcastle, have obtained the contract for the construction of the new line of railway from Daventry to Marton, near Leamington, and a commencement has already been made. The amount of the contract, it is believed, is about £150,000.

Messrs. Woodhouse and Rawson United Limited have received official notice from the Lords Commissioners of the Admiralty, to the effect that their name has been placed on the Admiralty list of firms who may be called upon to tender for the construction of unarmed wood-built boats and the supply of engines for the same.

Owing to the very serious depression in the South Staffordshire iron trade, the workmen in the employ of Messrs. Cochran and Co., bridge and girder manufacturers Woodside, near Dudley, have met their employers, and, in order to assist them to compete in the markets, have consented to submit to a reduction of 5 per cent. in wages all round. The workmen number nearly one thousand.

The quarterly return of cutlery exports from Sheffield to the United States shows that the M'Kinley tariff still operates prejudicially. The value of cutlery sent to the States during the last three months is £31,000, a falling off of nearly 50 per cent. as compared with the period before the adoption of the M'Kinley Act. The demand for the best qualities of cutlery is good, but the cheaper sorts have been driven out of the American market.

Wheel cutter in metal only. [illegible] description of gearing. R. CHIDLAW, 43, Cray-road, Manchester.

Having regard to the enormous circulation of THE MECHANICAL WORLD, the Editor suggests that it is by far the best medium for the insertion of every kind of "Wanted" advertisement, and the price is only one half-penny per word. The Editor will be glad if MECHANICAL WORLD readers will kindly bear this in mind as occasion arises.

Notes on the Design of High-pressure Steam Generators.

By B. H. Thwaite.

(*Continued from page* 136.)

The importance of preventing the deposition of the foreign matter on the heating surface will now, the author trusts, be fully recognised.

On this point it may be observed that the evil is exaggerated by the introduction of the hydrocarbon lubricants (volatilisable or decomposable by heat) into the boiler with the condensed water, and especially so when salt water is employed to make up for the displacement.

The influence of the deposition compound of the constituents named is to set up active oxidation of the metals, the influences at work being both electrical, chemical, and thermic. The lubricants in combination with magnesia form an oil-soap, which is more adherent to the furnace plates than the salts, and more pernicious.

Besides the interference with the transmission of heat, the scale increases the temperature of the plate, and with it its dilatancy. This increase has recently been exactly determined by Hirsch.

With a layer of plaster of Paris of only $\frac{1}{22}$in. in thickness, the temperature of the plate and the plaster differed by an increase of 54°. When the plaster was increased to a thickness of $\frac{3}{16}$in., the temperature difference was increased by 63° to evaporate steam at a temperature equivalent to 30lb. to the inch. To evaporate steam at a pressure of 40lb., the difference was increased to 378°, a temperature of a most serious influence on the safety of a boiler, when it is known that the difference between the temperature of the heat-transmitting metal and the water should never exceed 180°. It will be clearly seen that with clean metallic surfaces and a rationally-conceived design of steam generator, there never need be a fear that with water-covered surfaces intense heat will produce overheating. Of course, it will be understood that only a thickness of metal equivalent to the safety limit of the tensile strain to which the boiler will be subjected is provided, and not an unnecessary thickness by overlapping.

It has been proved, as already stated, that the resistance of the flow of heat is increased in proportion to the metallic thickness, and therefore the metal of the longitudinal lap or other joints attains a higher heat and offers greater relative dilatancy than the thinner one. A perfect design should, therefore, obviate the use of riveted joints in the zone of the influence of intense temperatures. It is to be desired as a future benefit that the development of electric welding will enable perfect metallic jointures to be effected, without the necessity of an increased thickness of metal.

The ordinary marine, Lancashire, and Cornish boiler appears to be built as if intended for the mere precipitation of the foreign and solid constituents of the water.

The principle of establishing a violent eroding character of circulation of the water over the heating surface has never, apparently, entered into the problem of the Cornish, Lancashire, and marine steam boiler design.

The examination of any Lancashire or Cornish boiler shows at once that the maximum scale accumulation is coincident with the most objectionable *locale* for such a deposit—*i.e.*, over the furnace crown part of the flue, which is exposed to the hottest part of the flame.

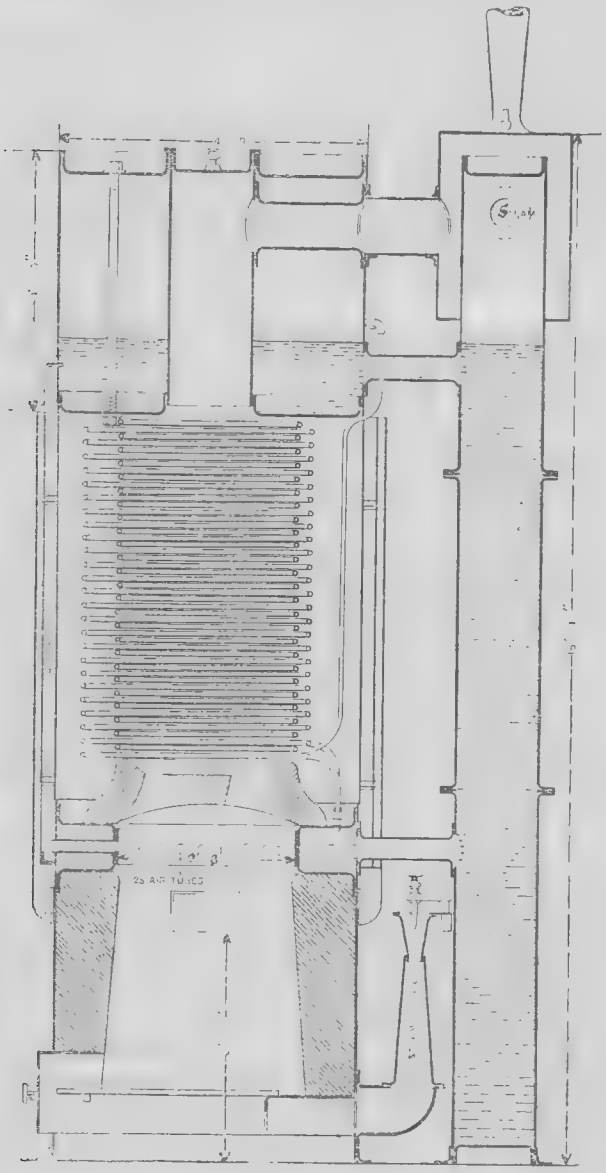


Fig. 4.

By the proper study and application of the laws involved in the production and maintenance of circulatory currents, a condition of flow can be established of such an erosive character that the deposit, whatever its origin may be, can never retain its position on the plate, but is swept off into suspensions as fast as it is deposited, because, *pari passu* with the heat of combustion that would bake any calcareous deposit on the flue, there is established such an erosive character of circulatory current that the lime or other matter deposited is eroded and swept into suspension.

The distribution of the water space and elements of heat transmission should be such that the circulation currents will be definite and distinct. The upward currents should not clash with the downward flow.

In the design of ordinary Lancashire, Cornish, or marine boilers, this axiom is either overlooked or ignored, and there is consequently in this class of steam generator either a chaotic condition of circulatory currents or no definite circulatory currents at all.

That the science of fuel combustion in the furnaces of the generators of the type mentioned is not understood, can be readily recognised by a glance at any factory chimney or steamer funnel. We there see volumes of smoke or unburnt fuel, synonymous with flagrant waste, for which there cannot be formulated an adequate excuse. Besides the waste of thermic or heat assets, the influence of the deposited carbon on the heating surface, as a factor of interference with the flow of heat through the plate, is strikingly conspicuous, and is alone an important source of heat loss.

The hydrocarbons evolved from the fuel are only very partially consumed, and as these hydrocarbons may be said to constitute $\frac{6}{24}$ of the heat value of the fuel, the proportion thus lost is consequently a very considerable one.

The methods ordinarily adopted as a setting for the Lancashire and Cornish boiler is responsible in many applications for much corrosive action, and the external plates of the boiler are not so accessible for examination as regard for safety requires.

It may be justly affirmed that no design of steam generator fulfils the condition of safety that is not accessible for examination at every part, and, judged by this characteristic, neither the marine, the Lancashire, nor the Cornish boiler is perfect.

The neglect or evasion—whether intentional or accidental—of the physical, chemical, and thermic actions enunciated, is responsible for untold evils and incalculable loss, while the progressive tendencies towards higher evaporative steam generating efficiencies and higher steam pressures only accentuate the evils of the design of the condemned types.

Anyone cognisant of the conditions required to satisfy a high efficiency according to the law of Carnot, must realise that higher practical efficiencies with steam thermodynamic motors can only be attained by the employment of wider ranges of temperature, and these greater ranges are only possible with higher initial steam pressures.

In order to meet the influences of the several active conditions enumerated as far as practicable, the following axioms of perfect steam generator design may be deferentially suggested:—

(1.) The application of heat to the internal flue or other heating surface should be as uniform as possible.

(2.) The heating surface exposed to the most intense zone of combustion should be covered with active currents of a well-defined direction, and of such an erosive character as to absolutely prevent the settled deposition of calcareous or other matters of a heat non-conducting character.

(3.) That the structural characteristics of the heating surface just described shall be of a flexible character, so that the maximum metallic dilations shall be easily compensated for in the range of flexibility.

(4.) That the structural character of the heating surface shall be such as to promote a distinctive direction of circulation, so as to avoid the clashing of the currents.

(5.) That the arrangement of parts shall include the provision of a foreign-substance depositing vessel, quite removed from the zone of heat, and such as to be easily accessible for examination.

(6.) That there shall be no metallic part of the structure so rigidly formed that the expansion or dilating influence of heat to which it may be subjected shall produce dangerous stress.

(7.) That the form of construction shall be such as to permit pressures up to 300lb. to the square inch to be obtained, without necessitating an abnormal thickness of shell plate.

(8.) That the steam generator shall be accessible for examination on all sides.

(9.) That the chemical action of combustion shall be thoroughly under control, so that absolutely perfect combustion shall be possible.

(10.) That both the rate of producing combustible gas from the solid combustible, and the supply of the volume of air for its oxidation or combustion, shall be under control.

(11.) That the external or outer shell radiation shall be reduced to the lowest limits.

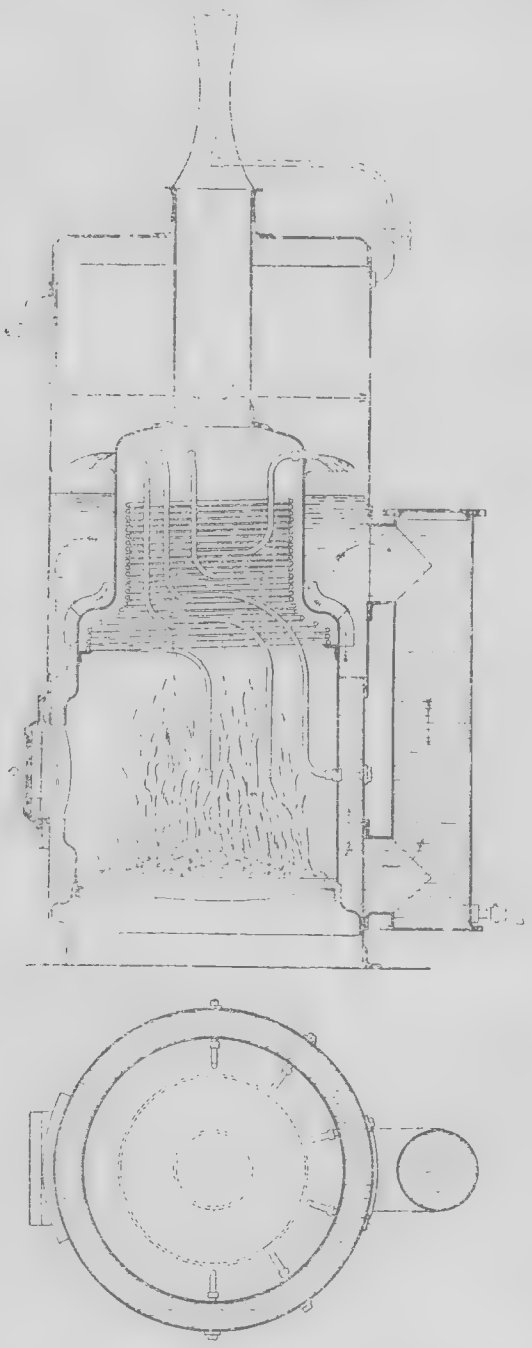


Fig. 5.

The faithful adherence to the axioms specified would mean the more or less condemnation of the most general form of the horizontal internal flue boilers.

The water-tube type of steam generator satisfies many of the canons of good design; unfortunately, the largeness of the tubes and the fact that, excepting in some of the later types of boilers of this class, there is no distinctive or continuous cycle of circulation, are characteristics responsible for scale formation. Nevertheless, as in most modern innovations and improvements, American engineers have shaken off in the water-tube type of boiler the follow-my-leaderism in engineering design, and have mounted a few rungs higher in the ladder of progress towards ideal perfection.

An approach to the ideal steam boiler was initiated by Perkins. This was further developed and improved by Hereshoff and Rowan, but the misfortunes attending the first application of the latter upset its chances of general application. Du Temple made a considerable advance on Rowan, and introduced a type of steam generator that satisfies many of the suggested canons of design. Thanks to the intelligence of one of our most progressivist engineers, Mr. Thorneycroft, this type of boiler has been Anglicised, and in this form has triumphantly emerged from lengthened trials of every-day experience; it is undoubtedly to this tubulous, or very small tube type of boiler, that we must look to for the ideal form. Indeed, other engineers will quickly realise that to fulfil all the conditions set forth, no other type of steam generator design is permissible.

The author alone, and along with Mr. Charles Browne, of Basle, have for some years given the closest study to this question, and have evolved a series of designs. The latest type is shown in Fig. 4, which is an attempt to satisfy the laws of good design by a modification of a vertical flue and tubulous boiler. The novelty of the arrangement (which is gas fired) is the method by which the flow of flame combustion is confined to the water-covered heating surface of the boiler, and in the manner of arranging a partially refractory lined combustion chamber.

Another novelty of design is the method adopted to induce definite directions of circulatory currents by the employment of a vertical curtain plate, so disposed in the nest of gas-tube heating surface that the always visible water down-flow trunks, through which the water in circulation slowly descends, and in which the separated foreign matter is deposited, and is therefore never exposed to the influence of heat. Two side cylindrical horizontally-placed water tubes of the comparatively large diameter of 12in., which connect the down-flow water trunks to the nest of flexible water tubes, and thus complete the structural elements of the circulating arrangements. The terminal connections of the small tubes are all accessible and easily adjustable. All the tubes are easily accessible for removal or repair. The erosive action set up in these small tubes is such that the internal surface of the tubes is actually polished; and Mr. Thorneycroft records the fact that after three years' experience at sea with one of his type, the tubes were quite clean from incrustation.

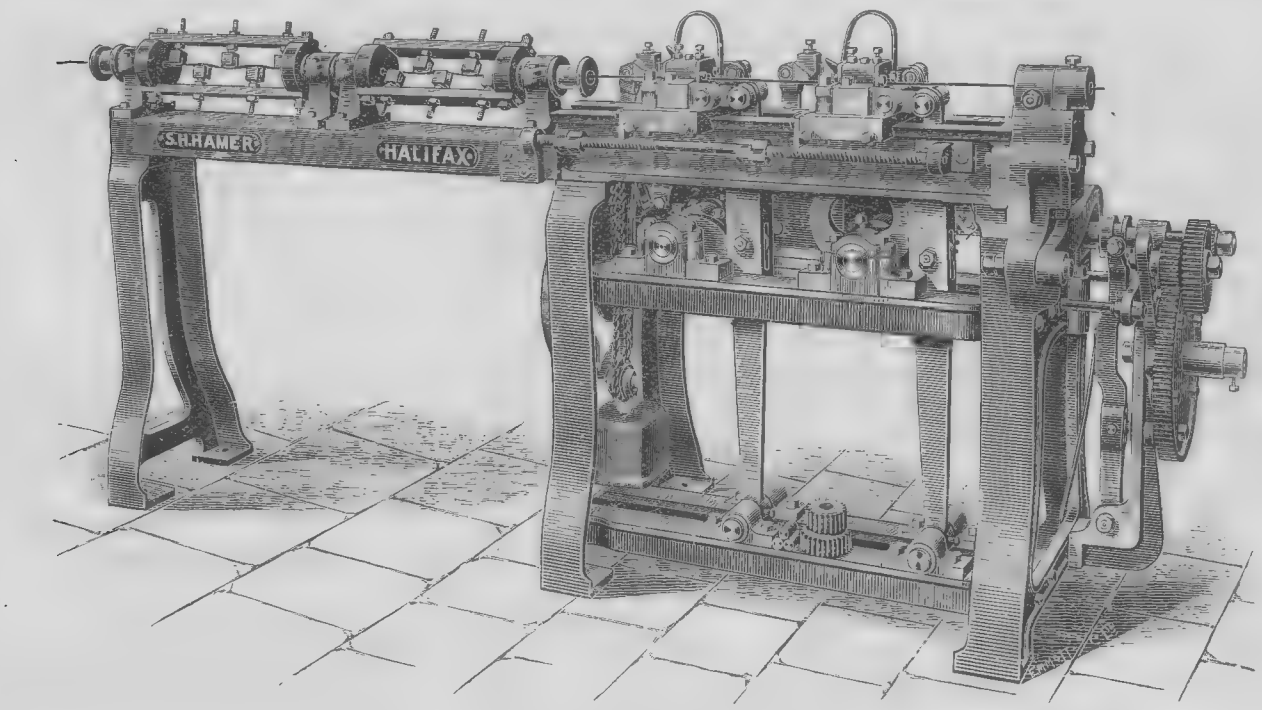
It may be accepted with the most complete confidence that a small-bore water tube with a free internal and continuous flow of water can never be raised to a dangerous condition of overheating. We have repeated proofs of this in the blast furnace tuyères; and recorded experimental results confirm the truth of the statements. A steam generator of the type described has been erected by Messrs. Clarke, Chapman and Co., of Gateshead, for steam pressures of from 200 to 300lb. to the square inch.

Fig. 5 shows a design of a vertical type of tubulous steam generator recently designed by the author for high pressures, ranging from 200lb. to 500lb. to the square inch, and for electric-light machinery central station work, where high efficiency, high power, combined with compactness and economy of space occupied, as well as smokeless combustion, were required.

This steam generator will be seen to consist of similar constitutional elements, and differently arranged to the one described, but the fuel combustion arrangements are of a *quasi* gas-generator character. The fuel is consumed under pressure established with a steam jet air induction system.

The air for combustion is aspired to the *locale* of the combustion chamber. By means of a chimney steam jet aspirator, the air is aspired through an air jacket externally surrounding the combustion chamber. By this means the loss of heat by radiation is reduced to a minimum. and steam spray issuing from the upper ends of the small-bore tubes is ejected above the water level, and injected below this level. This arrangement not only enables the steam and water to be separated, but it also enables the complete circulation cycle to be established immediately the fuel is ignited.

There is a descensional water flow and calcareous and saline or other solid matter depositing trunk placed externally, the lower limb of which permits the accumulation of the solids free from the influence of heat, and thus prevents the solidification or baking of the foreign matters, which can consequently be easily blown off.



WIRE-STRAIGHTENING AND CUTTING MACHINE.

water flows in an upward direction, sweeping the central flue, and descends next to the inner surface of the outer shell.

A second design is a horizontal type of tubulous steam generator (see THE MECHANICAL WORLD, March 28, 1891). The essential characteristics of this design are as follow:—A large and shallow fire-grate for fuel combustion. A nest of flexible miniature or small-bore water tubes less than 1in. in internal diameter, and of a curved form, to permit of free dilation or expansion. A steam and water vessel in which the water level is maintained, and in which an arrangement is established for separating the steam from the water, and which is of such a structural form *per se*, that the longitudinal extension of the tubes can freely occur without straining the tube plates; the bulged or curvature side plates permit this. The provision of externally-fixed and The arrangement permits the exact distribution of the air to the combustible gases and the complete control of the fuel combustion. The nest of small-bore water tubes is composed of curve-shaped weldless steam tubing, and here it may be observed that it was considered by technical experts that were these rings or circles of small-bore tubes subjected to a pressure of 500lb. to the square inch, then the curved parts would have a tendency to open out straight. A careful hydraulic test at this pressure proved the surmise to be wrong. The tubes were not in the least distorted from the true circle.

The upper steam drum being merely exposed to the sensible heat of the gases of combustion, there is consequently very little irregularity in the application of thermic or heat influence.

It will be noticed that part of the water

The author trusts that the suggestions embodied in the paper will tend to provoke the rigid analysis of the merits of the designs of steam generators as at present constructed, measured according to the canons of design enunciated.

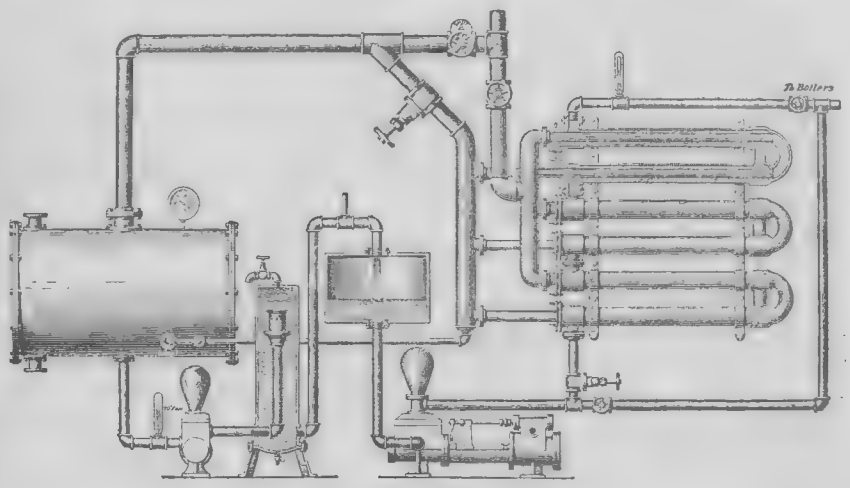
Automatic Wire-straightening and Cutting Machine.

THE illustration herewith shows an ingeniously-arranged automatic wire-straightening and cutting-off machine, made by Mr. S. H. Hamer, Range-lane, Halifax. With this machine the wire is automatically taken direct from the coil, straightened, measured, and cut off into any lengths up to 6ft. The "spinners" have planed wrought-iron sides and are perfectly balanced. One side of each "spinner" is loose in order to allow the wire to be inserted without disturbing or altering in any way the "set" of the straightening dies, thus effecting a saving both of time and wire. The wire in passing through this machine is not marked in any way, while it is straightened perfectly and cut to exact lengths, quite square at both ends. When working at full traverse 40ft. of wire per minute can be readily dealt with. Further particulars of the machine, which is made in various sizes, may be had on application to the maker at the above address.

PURE ALUM has been discovered in large quantities in a mountain situated about 30 miles east of Quetta, India.

A New Feed-water Heater.

A NEW DESIGN of feed-water heater, invented by Mr. Elihu Nelson, of the Mortimer Building, 11, Wall-street, New York, is shown in the accompanying illustration, attached between the cylinder and a surface condenser, as for marine work. The exhaust pipe from the engine, shown broken off at the top of the illustration, leads into a heater, from which three separate supplies are taken to the three loops of the heater, the area of the combined tubes being in excess of that of the main exhaust. Following it through the



NEW FEED-WATER HEATER.

top loop, which is shown in section, it will be seen that the steam passes through the top of loop toward and around the bend, returning through the lower side to the pipe leading to the condenser. The immediate passage of the steam into this pipe is prevented by the valve marked "shut"; but should it be desired to cut the heater out, the steam can be sent direct to the condenser by opening the valve and closing the two immediately below, or a portion may be allowed to go to the condenser direct by partially opening the top valve. The separate sources of supply ensure a positive circulation of the steam, and the water of condensation is carried by the small pipe shown from the bottom of the pipe into which the loops discharge to the condenser, where it mingles with the regular condensation water and is drawn out by the air pump into the separating tank beside the condenser. Where no heater is used, it is inexpedient to cool the water in the condenser too much; but as with this arrangement it can be reheated to nearly the temperature of the exhaust, the decrease in temperature and consequent vacuum is limited only by the amount of water which it pays to circulate. The amount of circulating water necessary is also reduced by the condensing action of the heating coils. In the separating tank at the low temperature attained the oil is allowed to float to the surface and the clear water delivered from the bottom to another tank as shown, from which it is pumped through the heater to the boilers. A float may be used in the latter tank to regulate the speed of the pump so as to preserve a constant water line, and prevent the pump from taking air. The water passes through the annular space about the steam pipe in a thin sheet, traversing the whole length of the six branches shown, in the present instance in the opposite direction to the steam current, and emerging within one or two degrees of the temperature of the steam with which its containing pipe has been surrounded. In this way it is brought about that the steam is admitted to the feed-water heater by multiple paths, and that it is practically fresh steam when it is met by the feed-water, first comparatively cool, then of a higher temperature, and then still further heated. The result is that the feed-water is raised to a temperature approximating very closely to that of the heating steam. It is one of the advantages of passing the feed-water and the steam in opposite directions that the water of condensation passes through comparatively cool, while the feed-water is heated to the highest possible degree. The different sections or groups of sections are connected up in such a way as to be in multiple arc between what may be called the main exhaust pipe from the engine and a branch exhaust pipe. The steam which is used for heating the feed-water is thus applied to small portions of it successively while the steam is at a great heat, thereby securing the greatest possible efficiency. There is no clogging or backing in the apparatus. As a matter of fact, a vacuum is created, which greatly facilitates the action. Beyond the condenser, the waters

of condensation are pumped through an oil separator or purifier, and into a receiver shown at the centre of the illustration. The water is cool enough so that the oil will rise to the top in the oil separator, where it can be drawn off through a suitable stop-cock. As to the coolness of the water after passing through the condenser, it may be stated that it reaches a degree which entirely admits of securing a high vacuum, as shown by an ordinary gauge. When there is no leakage, the vacuum runs from 26in. to 28in.

Manchester Association of Engineers.

THE thirty-seventh session of the above association was opened on Saturday, the 8th inst., by a social gathering of the members at the Grand Hotel, Manchester. About 80 members were present. The chair was occupied by Mr. T. Ashbury, A.I.C.E., who during the intervals in the musical programme drew attention to the list of subjects for the ensuing session, which, he said, could not fail to be both interesting and instructive.

Amongst the papers included in the syllabus are :—"Comparison of Friction in Cotton Mill Engines and Gearing to the Actual Work Done," by Alfred Saxon; "Economic Possibilities of the Generation of Electromotive Force in the Coal Fields, and its Application to Industrial Centres," by B. H. Thwaite; "Transmission of Power by Compressed Air," by W. J. Jenkins; "Felt Hat Manufacture and Machinery," by J. Marshall; "On the Relations Between Employers and Workmen in Engineering Works," by C. R. Iorns; "Calorimeters," by A. G. Brown.

With the view of affording the members an opportunity of overcoming any question or engineering difficulty which may have occurred in ordinary workshop routine, a special meeting is set apart for "Topical Engineering Questions."

A special meeting is also arranged for a discussion on the "Best Mode of Construction and Lubrication of a Main Bearing."

The gathering was a great success, and was concluded by a hearty vote of thanks being passed to the various gentlemen who had contributed to the musical programme.

London Association of Foremen Engineers and Draughtsmen.

THE usual monthly meeting of this association was held on the 1st inst., in the K room of the Cannon-street Hotel, when the president, Mr. F. J. Garnish, occupied the chair, and the vice-president, Mr. James Brown, the vice-chair, and there was a large attendance of members.

After the nomination of new members and other general business was finished, a paper was read by Mr. R. J. Bott, on "Electricity from the Supply Company to the Consumer," which was well illustrated by diagrams and incandescent lamps worked from storage batteries, and was listened to with much interest.

In the course of his remarks Mr. Bott dealt with the different methods of producing the electric current by means of machinery in a central station, and mentioned that on the Continent the system of driving moderately large dynamos by means of large slow-speed engines was generally in use. In America, on the other hand, the system of production was by means of high-speed engines, driving very high-speed dynamos; while we in England had got into something between the two, and generally used high-speed engines coupled direct to the armature of the dynamo. The latter system he considered to be the best and most economical, especially in large towns, where ground was high in price and difficult to obtain in crowded areas. Mr. Bott then described the usual method of distributing low-tension current, and explained that the limit of distance was soon reached on account of the expense of the copper mains required, which led to the introduction of the three-wire system, by means of which the current can be taken at double the pressure, and explained the method of leading feeders from the dynamos to the mains at long distances, so as to keep up the pressure for distant lamps.

He then described the high-tension system, by which the current is taken from the mains at a very high pressure, and by means of transformers reduced to a working pressure before passing to the lamps. One hundred and ten volts being practically about the limit of pressure for incandescent lamps, the high-pressure current has to be reduced to something below this to avoid damage to the lamps. This reduction of pressure is effected by the transformer, which is a core of iron wire or sheet iron plates over which is wound two sets or coils of wire, one a thin or primary wire through which the high-tension current passes, and the other a thick or secondary wire which is carried to the lamps. The high-pressure current passing through the small wire induces a current of low pressure in the secondary or thick wire, suitable for the proper burning of the lamps. He stated that the high-pressure system was good for conveying the current long distances with a small expense for mains; but, from a consumer's point of view, the low-tension was the best, as if by accident one came in contact with the mains, the results were not serious. Where high-tension current and transformers are used, the consumer must provide a fire-proof room for the converter to be fixed, which in a small house was sometimes inconvenient, and very frequently the transformer gives out a humming noise, which is unpleasant if heard in a house.

Mr. Bott was congratulated on the excellence of his paper, and received a hearty vote of thanks at the close of the meeting.

An Instrument for Calibrating Torsion Galvanometers.*

THIS is a new instrument brought out by the author, who is in the firm of Siemens and Halske, of Berlin. It enables a torsion galvanometer to be calibrated by means of a Clark standard cell, and affords means of checking the electromotive force of the standard cell at the same time.

In the main circuit are placed in series an accumulator, an adjustable resistance, not necessarily of known amount; a resistance box of 17 coils, each of 143·3 ohms resistance, of which one or more can be put in the circuit by means of plugs; a silver voltameter provided with a plug for short-circuiting it, and the torsion galvanometer to be calibrated. A second shunt circuit is joined to the ends of the resistance box, and this circuit contains a key, a reflecting galvanometer, a carbon resistance of about 100,000 ohms, and a Clark standard cell. The method of testing is as follows :—The silver voltameter is cut out of the circuit. It is obvious that, by adjustment of the resistance coil near the accumulator, a potential of exactly 1·433 volt can be obtained between the terminals of the 17-coil resistance box. The Clark cell gives also 1·433 volt, and as it is coupled in the reverse way to the accumulator, when a balance is obtained, the mirror galvanometer will remain at zero, while the test-key is pressed down. Supposing this to be the case, if one of the coils in the box is plugged there will be a current of 0·01 ampère through the torsion galvanometer, which should give a deflection of 10° if it is correct; if not, the deviation is noted. Two coils are now plugged and a current of 0·02 ampère will pass, giving a deflection of 20°, and the tests are then carried on until the whole of the coils are plugged in parallel, giving a current of 0·17 ampère, and a deflection of 170° if correct. In order to make sure that the Clark cell is giving the exact potential of 1·433 volt, the silver voltameter is now put in circuit, a current of 0·17 ampère is used, and compensation again obtained as before; the galvanometer is then switched out and an equivalent resistance switched in, and the current allowed to flow through the voltameter for a given time. If the Clark cell is in good order, no variation will be found in tests carried on over a period of six months.

* Inst. C.E.: Foreign Abstracts.

Metal Trade Memoranda.

The directors of the Marbella Iron Ore Company Limited report the output of ore for September to be 3713 tons.

During the first eight months of the present year the Belgian blast furnaces have produced 498,020 tons of pig iron.

The Redbourne Hill Smelting Company have just relighted one of their large furnaces, which has been repaired and fitted with the most modern appliances.

During the month of September the Arizona Copper Company's mines produced 142 tons of black copper and 94 tons of matte. This is equivalent to about 208 tons of black copper.

The Cleveland ironmasters' stock returns for September show an increase of 7024 tons. The production reaches 217,000 tons, of which nearly half is hematite and steel-making iron, the remaining 109,000 tons being Cleveland brands. The total stocks in hand are 53,000 tons, including warrants, against 283,000 tons before the Durham strike, when 83 furnaces were blowing; now there are 90, the highest number this year, 50 being on Cleveland iron and 40 on other kinds. The increase in stock arises from small shipments to Scotland.

The Tinplate Makers' Association met at Swansea on the 6th inst., to consider a proposal emanating from the men, that in view of the effects of the M'Kinley tariff a joint conference of masters and men should be held to consider the best means of ensuring the prosperity of the trade in Wales. It was decided that no good result would be produced by such a conference at the present time.

The copper statistics issued by Messrs. H. R. Merton and Co. show that the copper trade is in a condition of stagnation. The total stocks at the end of September were 58,482 tons, compared with 59,718 tons at the end of August; but the supplies during the month were only 7132 tons, against 8735 tons in August. The deliveries during September were 8368 tons, against 8755 tons in August last, and 11,030 tons in September last year.

The South Chicago Foundry Company are putting on the market a high grade of castings, to which they have given the name semi-steel. It is stated that the mixture has more than double the strength of best grey iron, its tensile strength running over 36,000lb. to the square inch, while its breaking strength showed from 3450 to 3850 in a Riehlé testing machine for a 1in. square bar, 12in. between points. It is stated to be sound and homogeneous. It is not a substitute for malleable iron, but is designed to meet the demand for castings of greater strength than ordinary cast iron, and not so expensive as steel castings. The company have tested its merits in the manufacture of gears, crankshafts, rocker arms, crossheads, hammer dies, etc. Being of a very fine texture, it is recommended for smelting kettles, acid pans, and hydraulic, pneumatic, and ammonia cylinders. It is said that it can be chilled to any depth desired, from ¼in. upwards, without impairing its strength, the opposite side being soft, tough, and easily machined.

The Metal Market.

PRICES CURRENT.

LONDON October 10.

COPPER opened strong and excited on influential buying, three months being placed at £46 10s., a rise of 12s. 6d. on Friday's official close. A quieter tone soon followed, and three months sellers' option was done at £45 15s., but prices quickly rallied to £45 17s. 6d. cash and £46 7s 6d. three months, owing to good general buying. Profit taking caused renewed weakness, and three months declined to £46 5s., while for cash £45 13s. 9d. was accepted, and on the kerb three months dropped to £46 and cash to £45 11s. 3d., the final tone being quiet and only about 1s. 3d better than Friday's latest business. Sales, 1300 tons. Settlement price, £45 12s. 6d. English tough, £48; best selected, £49 10s.; strong sheets, £56.

TIN began with business for prompt delivery at £93 15s., and a sharp rise to £94 followed on prominent buying, £94 10s. being also paid for three months. Transactions were governed by these prices during the greater part of the day; but towards the close, in consequence of some selling pressure, future dates eased off to £94 7s. 6d for early January, and £91 5s. for early December The close, however, is steady, and 5s. better on the day. Sales, 170 tons. Settlement price, £93 17s. 6d. English ingots, £96 10s. to £97.

PIG IRON opened firm, and Scotch one month gained ½d, at 41s. 10½d. Later on a further gain of 1d. was made, cash being done at 41s. 8½d. and one month at 41s. 11½d, and towards the close 41s. 9½d. was paid for prompt delivery, making a rise of 2d. on the day. The market closed steadily and with buyers at the quotations. Sales, 2000 tons. Settlement price, 41s 9d.

TINPLATES quiet. I.C. cokes, f.o.b, London 12s. 9d.; Liverpool, 12s. 3d.; Swansea, 11s. 9d.

LEAD.—Spanish is quiet but steady at £10 12s. 6d. for spot, and £10 10s. for forward delivery. English, £10 15s. to £10 17s. 6d.

SPELTER has sold well at £18 17s. 6d. for October shipment, at which the close is firm.

ZINC SHEETS.—Silesian are firm but quiet at £21 17s. 6d. for usual marks ex ship. Belgian steady; V. M.'s, ex ship, £22; f.o.b. Antwerp, £21 15s.

OFFICIAL CLOSING QUOTATIONS.

	£	s.	d.	£	s.	d.
COPPER—						
G. M. B.—Cash	45	13	9	46	1	3
" Three months	46	3	9	46	11	3
English tough	—	—	—			
Best selected	—	—	—			
Strong sheets	—	—	—			
TIN—						
Fine foreign—Cash	93	17	6	94	7	6
" " Three months	94	7	6	94	17	6
Australian—Cash	94	7	6	94	17	6
PIG IRON—					s.	d.
Scotch warrants—Cash					41	9
" One month					41	11
Middlesbrough—Cash					Nom.	
" One month					—	
Hematite—Cash					Nom.	
" One month					—	

GLASGOW, Oct. 10.—The pig iron market was steady to-day. Warrants proved rather scarce, and, as iron continues to be taken freely from store, those oversold were anxious inquirers. Scotch was very firm, and the price rose 2d. from Friday, nearly 10,000 tons changing hands. One lot of Cleveland was sold, and sellers were left over at 1½d. under Friday's finish. The shipments of Scotch last week reached to 7639 tons, being 310 tons less than in the corresponding week of last year, and reducing the increase for the year to 27,101. It was reported this afternoon that two large steamers had been placed with Clyde shipbuilders.

QUOTATIONS.

	Highest.		Lowest.	
	s.	d.	s.	d.
Scotch warrants—Cash	41	9	41	8½
" One month	41	11	41	10
Middlesbrough—Cash	39	1½	39	0
" One month	—		—	
Hematite—Cash	49	10½	49	7½
" One month	—		—	

Official Gazette.

Partnerships Dissolved.

BARNES AND LOW, Exhibition-road, South Kensington, late of Sussex-place, South Kensington, electrical engineers.

BROMLEY AND HARRISON, Leeds, engineers and machinists.

J. PEARSON, W. NOCK, W. WHITEHOUSE, F. DOVEY, and B. G. SOUTHALL, under the style of the Herbert's Park Iron Company, Darlaston, ironmasters.

THE BANKRUPTCY ACTS, 1883 AND 1890.

Receiving Orders.

JAMES CHEDZOY LEE, Theobald's-road, and Devonshire-street, Theobald's-road, Holborn, W.C., and Windsor, gas engineer.

JOHN DERBYSHIRE, THE ELDER, Longton, engineer.

CHARLES WALTER COX and FREDERICK GEORGE ROBINSON, carrying on business as Cox, Robinson and Co., Liverpool, electrical engineers.

Adjudications.

JAMES SUNDERLAND (trading as Sunderland and Co.), Leeds, brassfounder.

JAMES CHEDZOY LEE, Theobald's-road, and Devonshire-street, Theobald's-road, Holborn, W.C., and Windsor, gas engineer.

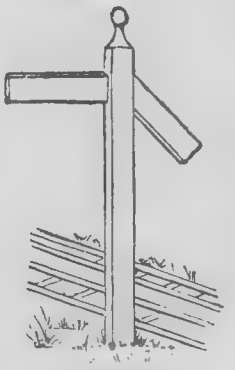
CHARLES WALTER COX and FREDERICK GEORGE ROBINSON, carrying on business as Cox, Robinson and Co., Liverpool, electrical engineers.

JOHN DERBYSHIRE, THE ELDER, Longton, engineer.

Trade Marks.

The following is the Official List of Applications published from September 21 to October 5, for the Registration of Trade Marks, so far as relates to the Metal Trades.

CLASS 1



WARNER

"The essential particular of the Trade Mark is the device, and I disclaim any right to the exclusive use of the added matter."

152,936—2596 S. Unwrought and partly-wrought metals used in manufacture, including iron and steel. PERCY WARNER, Sheffield; manufacturer.—23rd December, 1890.

CLASS 13.

R. GROVES & SONS USE SHEFFIELD

162,579—2782 S. Hammers, anvils, vices, and similar metal goods not included in other classes, being joiners' and other tools of metal, not having a cutting edge, in Class 13. ROBERT RENTON EADON, trading as MOSES EADON AND SONS, President Works, Sheffield; also as RICHARD GROVES AND SONS, Beehive Works, Sheffield; manufacturer.—9th February, 1892. Mark used by applicant and his predecessors in business for fifty years last past.

New Companies.

BUTE DOCK FOUNDRY LIMITED.—This company was registered on the 29th ult., with a capital of £10,000, in £5 shares, to purchase or otherwise acquire the Bute Dock Foundry, Cardiff, and to carry on the businesses of iron-founders, brassfounders, mechanical engineers, boiler-makers, millwrights, metal-workers, steel-converters, tin-plate and sheet-metal workers, japanners, enamellers, repairers and builders of ships, tugs, etc.

TAWE FOUNDRY AND ENGINEERING COMPANY LIMITED.—This company was registered on the 4th inst., with a capital of £2000, in £5 shares, to carry on at Llansamlet, in the county of Glamorgan, or elsewhere, the business of mechanical engineers, machine and engineering tool makers, brassfounders, etc, etc. Registered, without special articles of association, by Messrs. Waterlow Bros. and Layton, 24 and 25, Birchin-lane, E.C.

CLIMAX VENTILATING COMPANY LIMITED.—This company was registered on the 29th ult., to purchase goods and merchandise of every description, to purchase raw materials and manufacture such goods and merchandise, and generally to carry on the business of merchants, importers, exporters, and manufacturers of all goods, chattels and merchandise, and to sell and dispose of the same upon such terms as may be desired; to purchase or otherwise acquire any British or foreign patents, licences, concessions and the like, conferring any exclusive or non-exclusive or limited rights which may seem capable of being used for any of the purposes of the company, etc.

AKESTER ELECTRIC SYNDICATE LIMITED.—This company was registered on the 5th inst., with a capital of £15,000, in £50 shares, to carry into effect an agreement made between Mr. W. H. Akester, of the one part, and Mr. P. R. Low, on behalf of this company, of the other part, for the acquisition of certain patents relating to improvements in electrical arc lamps, and to develop and turn to account the same, and as electrical engineers generally.

UNITY ELECTRO-PLATING COMPANY LIMITED.—This company was registered on the 3rd inst., with a capital of £5000, in £5 shares, to carry into effect an agreement expressed to be made between Mr. J. B. Finnemore, of the one part, and this company, of the other part, for the acquisition of the business of a silversmith and jeweller now carried on by Mr. J. B. Finnemore, at 125, Great Charles-street, Birmingham, and to develop and carry on the same in all its branches. With slight modifications the regulations contained in Table A apply. Registered by Messrs. Kerr and Lanham, 3, Chichester Rents, W.C. Registered office, 125, Great Charles-street, Birmingham.

Letters to the Editor.

*** *We do not hold ourselves responsible for opinions expressed by correspondents.*

*** *The name and address of the writer (not necessarily for publication) must in all cases accompany letters intended for insertion, or containing queries.*

*** *Letters intended for publication in the current week's issue must reach our Manchester Office not later than by the first post on the Tuesday preceding the date of publication.*

THE GULLIBILITY OF INVENTORS.

To the Editor of THE MECHANICAL WORLD.

SIR,—I have just read your leader under the above heading, and am very pleased to see you show inventors that to be a member of the Parisian Inventors' Academy does not prove the value of their inventions, for the very reason that "no particulars of their invention are obtainable by an outsider," when merely application for the patent has been made. It seems to me that the Academy will give the medal to *anyone* if he will send the £2. I may say that in February last I received the honour (?), but did not send the £2, as I thought my invention would not be benefited by it.

E. T. NICHOLSON.

Rochdale, October 10.

Miscellaneous Items.

The men employed at the Montrose Foundry commenced working an eight-hours day on the 7th inst. The rate of wages will remain the same.

A new cable, three miles long and consisting of six insulated copper wires, has recently been laid between Fishers Island and New London, Conn., U.S.A.

The soldering of aluminium, which has long been a difficult problem, has been recently solved. By sprinkling the surface to be soldered with chloride of silver and melting down, the soldering is effected simply and satisfactorily.

There is an asbestos mine near Danville, in the province of Quebec, which is said to be the largest in the world. For 5 or 10 years it has been in course of development, and now consists of five pits, some of which are 300ft. long and 150ft. wide, exposing a large amount of mineral. Last year's shipments of the highest grade were nearly 1000 tons.

Messrs. William Cramp and Sons, of Philadelphia, will begin the construction of five new steamships for the Inman line as soon as the secretary of the Navy approves the plans and specifications. The vessels will be between 500 and 600ft. long, fitted with twin screws and provided with accommodation for 300 first-class and 200 second-class passengers. Their cost will be between 8,000,000 and 9,000,000dols.

Great interest was awakened in Holloway, London, on the 2nd inst., when a new iron girder bridge spanning the Holloway-road at the Great Northern railway station was placed, by means of rails and pulleys, into position on its abutments. It connects the new double line from King's Cross to Finsbury Park, which has been for a long time past in construction. The bridge weighs 280 tons, and 100 men were employed in the work, which, having been commenced in the small hours of the morning, was successfully finished about ten o'clock.

The building of the Siberian railroad is to be accompanied, among other things, by a more or less detailed geological examination of the country through which it will pass. The geological foundation of Siberia is comparatively unknown, and only a few limited districts, mainly the mining districts of Altai Nertschinsk, have thus far been made objects of careful geological research. The examinations now proposed will have a direct practical value, since they are to be made along the line of the railroad, and will afford information as to available water supplies, coal and iron ore deposits, and other underground riches which may help to materially reduce the cost of building the road. A prospecting party is to be put in the field at once, and it is to begin its operations in the Tobolsk-Akmonlinsk mining district, and in the Tomsk and Jenisisee departments.

Queries.

☞ Readers are invited to avail themselves of this section for practical information on questions relating to Mechanical Engineering and the Scientific Industries.

☞ Queries and Replies should arrive at the Manchester Office not later than by the first post on the Tuesday preceding the date of publication.

PLUMBERS' UNION.—Required the address of the secretary of the Operative Plumbers' Union.—PLUMBER.

COATING FOR WATER PIPES.—Can any reader tell me how to ascertain whether cast-iron pipes have been properly coated with Dr. Smith's solution?—WATER PIPE.

MOULDING SAND.—Will any reader inform me where the fine moulding sand is obtained, which is used for making small malleable iron castings in Walsall?—IRON FOUNDER.

SPEED OF LOCOMOTIVES.—Provided a railway line is laid as perfect as possible, can any engine attain such a velocity as to cause it to leave the rails owing to excessive speed only?—P. T. G.

ROLLING CONTACT.—Can any reader kindly inform me if there are any machines in use for any purpose which have two rollers, cylinders, or the like, revolving in opposite directions at the *point of contact*?—W.

SPEED OF FAN.—Can any reader give me a rule for calculating the speed a fan should run at to discharge a given quantity of air against a pressure of 2in. or 3in. of water. I mean in regard to fans such as are used on board ship?—B. E. J.

ALUMINIUM.—Can any reader inform me how I can get a brilliant polish on short aluminium tubes which have been turned in a lathe? I have noticed aluminium articles in shop windows beautifully finished, but cannot find out how it is done.—TUBAL CAIN'S SON.

HARDENING AND TEMPERING.—Can any reader inform me how to harden and temper a number of straight steel wires 13 gauge and 16in. long? I have tried several ways, but I cannot keep them straight. I may say that I have hardened them in oil, and one at a time.—BLACKSMITH.

LOSSES IN STEEL FURNACES.—Could any reader kindly inform me the average per cent. of actual loss, and the average per cent. of skull, in the charge of a Siemens open-hearth steel furnace working charges of from 30 to 40 tons? And also the percentage of loss in heating slabs and ingots in the Siemens regenerative gas furnace?—J. R. R.

CUTTING CHASERS.—Can any reader inform me what method is used by Sir J. Whitworth and Co. to cut up their screw chasers, both inside and out? Or can any reader advise me as to the best method of cutting up inside and outside chasers when high-class mechanical efficiency is required, such as would be necessary in making standard gauges? Is there any method by which one can ensure a chaser retaining its proper angle after going through the hardening process?—A. KIRBY.

CAMS AND BOWLS.—(1.) When subject to little pressure, studs work in the cam race without any roller or bowl on them. At what amount of pressure ought a roller to be used on the stud to work in the race? and how is the pressure on the stud to be calculated for a cam to turn rotary motion into to-and-fro straight motion if the groove or race is 12in. diameter and moves a bar 4½in. in each direction? (2.) What is the pressure on a wiper cam to lift 2cwt. at 1¾in. from shaft? and also, what is the strain on the cam shaft, and how can I find it for other wipers? (3.) What is the pressure on the ball bearing in a ball mill, and how is it found? The mill is to grind 75lb. at a time, and the ball works in a hemispherical footstep bearing and at end of inclined spindle, the top end of which makes a circle of 1ft. diameter in turning. Weight on spindle about 1 ton.—OATS.

LOCOMOTIVE CONSTRUCTION.—Will any correspondent enlighten me as to the mode adopted in locomotive work in order to fix the position of the axles (horizontally) so that each axle may have a predetermined portion of the total weight resting upon it? Say:—

Load on leading axle	0·32
" driving "	0·48
" trailing "	0·20
	1·00

Of course I am aware there are certain circumstances—such as length of barrel, position of firebox, etc.—which in practice to a great extent influence this; but the point I wish clearing up is: Given the total weight, how are the positions of axles determined so that the prearranged weights rest on them? An answer would be of service to others as well as to—HILLSLAND.

Replies.

☞ Owing to the constant increase in our correspondence, we regret that we have no alternative but to announce that we cannot reply by post to Queries even when stamped envelopes are sent.

☞ Queries and Replies must in all cases be accompanied by the names and addresses of the writers, as no notice will be taken of anonymous communications.

A READER.—You must apply to the War Office, Pall Mall, London.

A STUDENT.—The articles commenced in our issue for June 14, 1890.

W. D. WEBB.—Kelley's Directory is the best we know of. It is published at 51, Great Queen-street, London.

PAPER.—Such pulleys as you inquire for are illustrated and described in our issue for November 9, 1889.

JUNIOR ENGINEERING SOCIETY.—The correct address of the secretary is: Mr. W. T. Dunn, 23, Fentiman-road, London, S.W.

J. OLDHAM.—Messrs. Dutton and Co. Limited, Shrub Hill, and McKenzie and Holland, Vulcan Ironworks, both of Worcester.

T. S. R.—Multiply the diameter by itself, and the product by 0·7854. You will find a full table in "The Mechanical World Pocket Diary."

A MECHANIC.—You have been correctly informed. The first spring when compressed until the coils touch acts simply as prolongation of the weight.

GAS.—If you apply to the Gaseous and Liquid Fuel Supply Company, 25, Market-street, Manchester, they will send you a copy of their very complete catalogue of such apparatus.

J. W. HAIGH.—You do not say how the wheels are coupled together. They can be made to turn in the manner you suggest if suitable intermediate gearing is used.

SPARK.—(1.) We should recommend 3in. for both suction and delivery. There is a limit to the length of pipe, owing to friction. About 250ft. might be used. Your pump should be of gun-metal. (2.) 28 threads is in accordance with the Whitworth standard.

M. H. MAW.—At present we have no particulars of the motors you refer to. Bourne's "Steam, Air, and Gas Engines," may assist you. We do not know of any published treatise on wind pressure. An abstract of a paper describing Prof. Langley's experiments was given in our issue for March 25, 1892.

LEARNER.—To fully explain the calculation would occupy a large amount of space, besides which the subject is most fully gone into in our issue for May 10, 1890. All the points you refer to are taken into account, and you cannot fail to profit by a perusal of the whole of Mr. Brown's paper on the indicator.

WOOD PULP.—Can any correspondent inform me of any process for softening oak chips or shavings into a pulp?—R. C.—*A.*—"R.C." will probably find a full account of the method of treating wood chips for paper making in any of the treatises on "Paper Making." The wood chips or shavings are put into large "digesters," soda ash and other chemicals introduced, and high-pressure steam turned on until the chips are thoroughly separated. It is then washed out into vats to drain off the chemicals, when it is ready to undergo further treatment for paper making. For further particulars consult some good modern work on paper-making machinery.—G. A.

MARINE ENGINEERS' EXAMINATION.—Will any reader inform me of the qualifications of an engineer on board ship? How such situations are obtained, and particulars of examination?—A. G. K.—*A.*—A situation as sea-going marine engineer is obtained, like many others, by influence at the first onset. Any mechanic who thoroughly understands large engines can soon learn the work. Posts below that of second engineer are tenable by persons having no certificates, and in small boats the berth of second engineer is so tenable. The "second engineer's certificate" is obtained by examination before the Board of Trade examiners. Qualifications for entering this examination are:—Three years apprenticeship in an engineering works, and twelve months actual time at sea in charge of a watch. The examination is simple and practical, involving a knowledge of the parts of the engine, precautions for safety, proper care of engine while running, and repair of breakdowns. A little simple mensuration and arithmetic are also involved. Reed's "Engineer's Handbook," 12s. 6d., is a complete guide to these examinations, and contains all particulars as to qualifications and rules which can be required.—T. J. B.

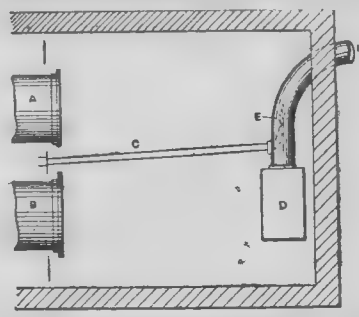
PEAT COAL.—I shall be very pleased if any reader of your valuable paper can give me some information on the above subject. I am desirous of knowing what firms manufacture it; its properties as a heating agent; what is its heating power in comparison with ordinary good coal; would it be a cheap fuel for firing boilers?—J. W. GEMMEL.—*A.*—According to Box, peat in its natural state of dryness contains 0·464 carbon, 0·048 hydrogen, and 0·248 oxygen. The oxygen will combine with 0·248÷8=0·031 hydrogen, leaving 0·048−0·031=0·017 hydrogen in excess, and we have:—

Carbon.....0·464×12,906=5988 units.
Hydrogen in excess..0·017×62,535=1163 "
7151 units,

or total heat. The total heat in coals is 13,000. The economic value of coals is given as 6000 units. That of peat will be $\frac{6000\times7151}{13,000}$=3300 units per lb. We therefore require $\frac{115,268\times24}{3300}$ = 838lb. of peat. But experiment gave 807lb. Therefore $\frac{115,268\times24}{807}$= 3428 units per lb., or $\frac{3428}{7151}$ = 0·48, or 48 per cent. of the total heat in the fuel. Its value as fuel may be reckoned as half that of good coal. As to whether it will be cheaper than coal will depend on their relative price delivered at the furnace. I do not know the names of any firms dealing in it.—G. A

BOAT PROPULSION.—If a boat floats down a river, will it be carried forward at the same speed as the stream is flowing? Or can it be proved that it will go slower than the stream? How much force in lb. will be required to propel a boat of a given weight against a stream or up a river flowing with a certain velocity, so that the boat shall move up the river with the same speed that the stream is flowing down?—HYDRA.—*A.*—This question involves many principles of hydraulics and for its satisfactory solution the elimination of many disturbing elements. First, suppose that the boat floats absolutely on the surface—has no draught at all,—and that the air is absolutely still. Then the boat will move slower than the stream to the extent of the retarding action of the friction of the air through which it passes. Secondly, suppose the action of the air removed, a vacuum to exist, and the boat to have an appreciable draught; then the question arises as to the velocity of a stream at different depths. Experiments have been adduced to show that in deep streams the maximum velocity of the water is at some point *below* the surface decreasing regularly above and below this point. In this case the velocity of the boat would be about equal to the mean velocity of all the layers of water from the surface to the depth of the lowest portion of the boat—*i.e.*, the boat would move *faster* than the surface of the water. The *maximum* velocity more often, however, would appear to be *at* the surface, and in this case the boat would move slower than the surface water. Find by attaching a Salter's balance between the fixed mooring and the bow of the boat what the force in pounds is which keeps the boat in its place against the stream. Then four times this force will be very nearly that required to propel her up stream at the same rate that the stream flows down, as this means going *through the water* twice as fast as when the boat is moored against the stream, and the resistance to propulsion varies as the square of the speed.—T. J. B.

STEAM JET.—Will any reader kindly enlighten me as to some plan for discharging ashes from the stoke-hole of a boiler house by means of a steam jet? My idea of such an arrangement will be best shown by the accompanying sketch, which is a plan of the front end of the boiler house. A and B are two Lancashire boilers, each about 28ft. × 7ft. diameter, and working at a pressure of 60lb. C, steam pipes from boilers ending in a nozzle E, which is inside the discharge pipes F. D is an iron box with a suitable air-tight lid. The ashes to be



discharged are emptied into the box D and the lid closed. Steam is then allowed to blow through the nozzle E. The suction thus caused is supposed to draw the ashes from D, which are then blown out through the discharge pipes F by the steam jet at E. In my case the vertical height from D to the point where the ashes would be discharged outside the boiler house would be about 13ft. A sketch, with sizes of steam pipes, ashbox, and discharge pipes, would greatly oblige.—G.A.B.M.

—*A.*—I think you will find the arrangement you suggest impracticable, especially if there be much clinker in the ashes. In any case it would not be economical, as it would require a considerable quantity of steam. Your best plan, it seems to me, would be to put in a small bucket elevator; it would require very little power to drive, and if your boilers have stokers on them it would be easy to arrange a drive off the shaft working them. If you state the quantity of ashes in cubic feet to be dealt with. I will be glad to give particulars of suitable elevator.—G. A.

INJECTOR.—Will any engineer give me reliable data for calculating the quantity of steam it would require to work an injector that would lift 1000 gallons of water 10ft. high in one hour, into a tank or empty boiler?—G. A. B.

—*A.*—The following formulæ will give the quantity of steam needed. Let H = heat taken up by water = total heat of steam used − the temperature of delivered water. W = lb. of water per hour delivered. I = increase of temperature as shown by thermometer—*i.e.*, difference of temperature between the feed and water delivered. S = steam used in lb.

Then $S=\frac{W\times I}{H}$. Example:—1000 gallons = 10,000lb. Feed-water 65° F. delivered to boiler at 200° F., using, say, exhaust steam total heat of which is 1178° F. H = 1178° − 200° = 978° F. I = 200° − 65° = 135°. Then $S=\frac{10,000\times135°}{978}$ (= 1383lb.—G. A.

—*A.*—The following formula will be found to furnish you with the necessary particulars for ascertaining the amount of steam used by injectors, pulsometers, etc. Let x = weight of steam per hour in lb.; W = weight of cold water lifted per hour; T = temperature of water in delivery pipe; t = temperature of cold water; H = total heat of steam from 32° used at pressure P; h = total number of thermal units given up by each lb. of steam; L = gross lift of pump in feet; l = height of suction; S = weight of steam per H.P. per hour, x = work done per hour in thermal units / therm. units given up each lb. steam at pres. P.

Work = $a+B+c$. a = the thermal work in raising the temperature of water. B = mechanical work done in lifting cold water from well and delivery to tank. c = mechanical work in lifting condensed steam from injector and delivery.

$x=\frac{a+B+c}{h}$ $\quad a=W(T-t)$

$B=\frac{W\,L}{772}$

$\therefore x=\frac{W\,[772\,(T-t)+L]}{772\,(H+329T,-(L-l)}$ $\quad c=\frac{x\,(L-l)}{772}$

$h=H+2-3T$

$$\text{Useful H.P.}=\frac{W\,L}{60\times33,000}$$

$$S=\frac{198,000\,[772\,(T-t)+L]}{L\,[772\,(H+32-t)-(L-l)]}$$

This formula, however, is awkward and inconvenient to carry about, and so I would advise the adoption of the following simpler form:—Let W = weight of cold water lifted per minute; L = gross lift of pump in feet; T − t = R = rise in temperature of water; h = thermal units from 32° = say a constant = 1125. Steam used per hour

$$=\frac{60\,W\,R}{1125}$$

Steam used per hour per H.P.

$$=\frac{60\times W\,R\times33,000}{1125\times W\,L}=\frac{1760\,R}{L}$$

The above formula works out for the case in point

5181b. per H.P. per hour.

$$\text{H.P.}=\frac{W\,L}{60\times33,000}=\frac{10,000\times10}{60\times33,000}=\text{A}$$

∴ Steam required to raise water

$$=\frac{518}{20}=25\text{lb.}$$

—H. W. U.

CONDENSER FOR MILL ENGINES.—Can anyone give me information, from practical experience, about a form of condenser called the evaporative or open air condenser, for use where water is scarce and expensive? A number of pipes in communication with each other are fixed over a large shallow tank and exposed freely to the atmosphere. The [illegible] of the pipes are in communication with the exhaust steam pipe and the air pump. On the outsides jets of water flow, a portion of which is evaporated and flies off as steam. I want to know whether [illegible] satisfactory in use. [illegible] the engine-house roof [illegible] steam flying off [illegible] from a boiler [illegible]

when exhausting into atmosphere. Approximate cost for 200I.H.P. Surface of pipe required per I.H.P. Best size of pipe to use. Whether any expense or trouble to keep in working order. Whether a new idea. I have been informed that the quantity of water required for this condenser does not exceed one-half the amount used by a non-condensing engine of same power *for boiler feed alone*, the only loss being that evaporated from the surface of the pipes, the condensed water being used in the boiler over again, as in the case of the ordinary surface condenser. Any information will be much appreciated.—CONDENSER.—*A.*—The condenser you refer to is, I think, that known as Perkin's; but I am not able to give you any particulars of it. I believe it was described some years ago in the leading engineering journals. I rather fancy it was not a success. You will find in "Engineering" for December 10, 1875, an account of an elaborate series of experiments on the surface condensation of steam, by Mr. B. G. Nichol, of Newcastle. The data there given might serve as a basis for your purpose. Consult also Box's treatise on "Heat."—G. A.—*A.*—In reply to "Condenser," I beg to inform him that such an apparatus as that to which he refers is manufactured by Messrs. Klein, Schanzlin and Becker, of Frankenthal, Rhenish Bavaria. Many of these condensers are in use in Germany, and are perfectly successful, and if placed on the roof (as frequently done) are not any nuisance whatever, either from noise or steam. "Condenser" has been accurately informed as to the quantity of water required to work such an apparatus, which is reckoned at about half the feeding water; but I do not know of any experiments in this direction. The only loss of cooling water is by evaporation; but the gain in condensing water more than counterbalances this loss. Messrs. Klein have another very successful condensing plant, which can be used where water is even more scarce than in the apparatus referred to by "Condenser." This system is known as air condensing, and is roughly as follows:—The circulating water, after passing through the condenser tubes, is pumped up into a tank at a proper height above the engine-room (say on the roof), and runs by gravitation over the surface of numerous wooden planks, and is met during this downward course by a powerful current of air from a fan which extracts the heat from the water, said heat going off in vapour into the outer air, and the cooled water dropping into a well beneath whence it is pumped in the ordinary way through the condenser, and the process repeated. I enclose rough sketch of arrangement, and may say this apparatus is at work in very many towns in Germany and other parts of Europe with the greatest success. The largest installation of the kind is at Düdelingen Ironworks, in Luxembourg, where air condensation for 2500H.P. is in operation continuously, and Messrs. Schukert and Co. have 1000H.P. at work on this system at Altona, and very many of 600H.P. at work, so that it is neither new nor experimental. The plant at Düdelingen condenses 56,000lb. of steam per hour. "Condenser" would do best to write to Messrs. Klein for information as to size of pipes required and cost; but I trust he will gather some useful information from the foregoing remarks.—FRED. A. YERBURG. [The sketch enclosed is similar to the illustration which appeared in our issue for January 19, 1892. Mr. A. A. Rickaby, Bloomfield Engine Works, Sunderland, would like to hear from you.—ED. "M.W."]

GAS ENGINE.—Will any reader inform me how the valves of a gas engine are set when in the shop, more especially the Otto type? An answer would greatly oblige.—GAS ENGINE.—*A.*—First put the cam shaft in position, with keyway cut ready to key cams on. Then slip the exhaust cam on to the cam shaft, having previously drilled and tapped a ⅜in. hole in the boss of cam, and having screwed a ⅜in. set screw in to hold the cam in position while setting. Next screw up set-screw in the exhaust lever till there is a full ¼in. clearance between the roller on lever and the boss of cam. Having done that, set the crank just over the inner dead centre, and slip the cam round till the second or closing side just takes up the clearance, then screw up set screw in cam to hold it in that position. If the cam is shaped to proper size, the opening point will be correct. To test that, pull the crank round to the firing stroke (if the engine is all complete it would be pulling it against the back compression). Then, supposing it is a 12in. stroke by 6in. diameter engine, the exhaust valve should have 1¼in lead—*i.e.*, be open 1¼in before the end of firing stroke. This is measured on the piston. Suppose 3in. of piston to be outside the liner when on dead centre; then the exhaust valve should open 1¼in. when piston is outside. If the opening and closing points are correct, slip a dummy key in the keyway of counter shaft, push one end against the cam, and scribe round, then the keyway will be marked off ready for the slotter. Having done that, slip the air cam on, screw up the setscrew on the air valve lever to give a bare ¼in. clearance between roller and cam, then bring the crank round to the inner dead centre as before—*i.e.*, when the exhaust valve closes,—and slip the first or opening side of cam against the roller on the air valve lever, so as to just take up the clearance; then screw up the ⅜in. setscrew in cam, it having been drilled like the exhaust cam. Then pull the crank over till it is ¼in. over the outer dead centre: the air valve should close at that point. Mark off keyway as before. The gas valve should be set to open ¼in. after the air and ⅜in. before—*i.e.*, just over the dead centre. The setting then is as follows:—Pull engine back against the compression, then pull it forward till 1¼in. from the end of stroke. The exhaust valve should commence to open at that point. Pull the engine over exhaust stroke on to inner dead centre. The air valve should commence to open ¼in. over dead centre; the exhaust closes, this allowing the exhaust gases to exhaust down to atmospheric pressure. The gas valve should open ¼in. over dead centre. The opening point is not very particular, but the closing point makes a great difference to the firing, and generally it ought to be set with the indicator. Having the crank on the inner dead centre, and the commencement of the suction stroke, pull the crank ¼in. over the outer dead centre. Here the air should close, the gas closing ¼in. or ⅜in. before. The reason for having the air and gas valve open over the centre is to destroy any vacuum there may be at the end of the suction stroke, and thus ensure a cylinder full for compression. In larger sizes the air valve is left open as much as ½in., and even more. The clearance between the roller and cam is to allow for expansion of valve spindle. The air cam does not need so much clearance as the exhaust; in fact, ⅛in. will do for the air in some cases, but this depends upon the proportion of leverage from pin to setscrew, and from pin to roller, as if the length of lever from pin to roller is twice the lever from pin to setscrew, ⅛in. expansion of valve spindle will take up ¼in. clearance between roller and cam, so that the clearance can only be determined by running a particular engine hot and setting accordingly.—E. J. DAVIS.

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Where complete specification accompanies application, an asterisk is suffixed.

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17,115 WATER ENGINE. G S Dobrashian.
17,120 VARIABLE EXPANSION VALVE GEARS. J Dunlop.
17,132 FLANGED JOINTS for PIPES. H Sparrow.
17,133 INCREASING the EVAPORATIVE POWER of STEAM BOILERS. J Hodgkinson.
17,142 AUTOMATIC BRAKE HOLDER. J T Brown.
17,151 WALL, TABLE, or FLOOR CONNECTION for PORTABLE ELECTRIC LAMPS. A P Lundberg.
17,154 HYDRAULIC JACKS. W R Fasey.
17,158 APPARATUS for LIFTING WEIGHTS in WAREHOUSES. T Abbott.
17,159 REFRIGERATORS.* C F Miller.
17,160 TELEPHONE SWITCH-BOARD APPARATUS. J E Kingsbury. (*The Western Electric Company*, United States.)
17,162 FRICTION COUPLING DEVICES.* G G M Hardingham. (*M Gawron*, Germany.)
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17,223 WELDING or WORKING METALS ELECTRICALLY.* W P Thompson. (*C L Coffin*, United States.)
17,224 APPARATUS for ELECTRICALLY HEATING and WORKING METAL.* W P Thompson. (*C L Coffin*, United States.)
17,225 APPARATUS for ELECTRICALLY WELDING METALS.* W P Thompson. (*C L Coffin*, United States.)
17,226 APPARATUS for WELDING or HEATING METALS ELECTRICALLY.* W P Thompson. (*C L Coffin*, United States.)
17,227 ELECTRICALLY WELDING or HEATING METALS. W P Thompson. (*C L Coffin*, United States.)
17,235 APPARATUS for ABSORBING SMOKE and NOXIOUS GASES ISSUING from LOCOMOTIVES. E E Dulier.
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17,246 ELECTRIC PRIMARY BATTERIES. T J D Rawlins.
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17,262 GAS.* R M Bidelman.

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17,277 APPARATUS for GOVERNING the SPEED of GAS or OIL ENGINES. H H Andrew and others.
17,287 SHIELD or COVER for ELECTRIC GAS LIGHTING PURPOSES. J Hamer.
17,304 ELECTRIC HEATERS.* T Ahearn.
17,309 STEAM VALVE.* H Grossmann.
17,312 SYPHON FEED PIPE for SUPPLYING WATER to TURBINES. A E Rodgers.
17,317 OIL FURNACES. F Tyers.
17,318 VENTILATORS.* J V Eves and M M Greeves.
17,321 ELECTRIC WATER HEATERS.* T Ahearn.
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17,365 DIRECT-ACTING STEAM ENGINES and PUMPS.* T Lockett and R Gough.
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17,381 TELEPHONIC INSTRUMENTS. J Muirhead.
17,382 ANCHORS. D Dishart.
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17,392 RAIL JOINTS. C U Fisher. (*The Heath Rail Joint Company*, United States.)
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17,395 STEAM TRAPS. C E Hearson.
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17,407 BALL BEARINGS. P Davies.
17,410 CONSTRUCTION of RAILS for RAILWAYS.* J Whittle.
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17,430 MINERS' SAFETY LAMPS. W H Johnson.
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17,450 STEAM ENGINES. W L Spence.
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17,495 STEAM and HAND CAPSTANS. H Keymer.
17,504 OPERATING ELECTRIC SWITCH. D Loch.
17,509 FIELD MAGNETS of DYNAMO-ELECTRIC GENERATORS. T R Andrews and T Preece.
17,513 APPARATUS in CONNECTION with SMITHS' HEARTHS for UTILISING the WASTE HEAT THEREFROM. A McDonnell.
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17,535 PIPE SUPPORT and PIPE JOINT. H E Wallis.
17,536 GRAPNELS for SUBMARINE CABLES. E Stallibrass.
17,538 HYDROCARBON MOTORS. J E Weyman and others.
17,540 VALVES for CONTROLLING the INLET and OUTLET of COMPRESSED LIQUEFIABLE GASES TO and FROM METALLIC STORAGE CYLINDERS. H Lane and J Pullman.
17,543 VALVE MECHANISM for USE in DIRECT-ACTING PUMPING ENGINES.* H G Holborow.
17,548 BOILER FURNACES or FLUES. J C Jobling and A J Davison.

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DRESSES FOR CHILDREN.
THOUGHTS ON SOME FLAWS IN OUR SYSTEM OF EARLY TRAINING.
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FRIDAY, OCTOBER 21ST, 1892.

Workmen's Old-age Pensions.

IT cannot be denied that we in this country are considerably behind our Continental neighbours in matters pertaining to the amelioration of the condition of our workmen. In several European States schemes of insurance or old-age pensions are in operation, and signs are not wanting that at some not very distant date a provision of a similar character will be instituted in this country. Various systems, compulsory and otherwise, have been suggested during recent years, but the conditions to be satisfied are many, and the difficulties in the way are not apparent to the superficial observer. Mr. J. Haysman has directed our attention to a scheme which appears to us to somewhat resemble that adopted by the Amsterdam branch of the Employers' Union of the Netherlands, which latter is reported to have worked well since its initiation in 1888. Mr. Haysman suggests that a compulsory scheme of old-age pensions should be promulgated for all who earn from 24s. to 40s. per week. To this end he advocates (1.) That Government pension stamps of 3d., 4d., and 6d. each should be sold to employers. (2.) That a 3d. stamp should be attached to the weekly wages ticket of all who earn from 24s. to 30s. per week, a 4d. stamp for those earning from 30s. to 36s. per week, and a 6d. stamp for those earning over 36s. per week. (For piece work the stamps should correspond in amount to those for weekly wages.) These stamps (which should be effaced by the rubber stamp of the employing firm) would represent about half-an-hour's work at the rate of wages paid, which time (five minutes per day only) should be made up by the employed to maintain their independence. The stamped wages tickets should be paid into the local post office, and the holder's pension book marked with the official stamp of that office for the amount paid. The completion of 30 years' pension stamp payments should entitle, at the age of 55 years, to a pension of 8s. per week, at 60 years 9s. per week, and at 65 years 10s. per week. In the event of death before the completion of 30 years' payments, it is proposed that the total amount subscribed should be refunded to the family of the deceased. If death occurred during the first, second, or third year of receiving the pension, the balance of three years' pension should be paid to the family of the deceased. This scheme appears to have much to recommend it, but employers will not, we anticipate, view the suggestion with altogether unmitigated satisfaction.

Guaranteed Electric Cars.

THE cost of maintaining storage batteries for traction purposes has long occupied considerable attention at the hands of electrical engineers, who have hitherto not been able to bring forth satisfactory data on the subject. Some time ago the Electrical Power Storage Company undertook to maintain the E.P.S. cells at a certain rate, and now the company has enlarged its proposal in a circular letter which has been despatched to the chief tramway companies in the United Kingdom. The circular calls attention to the fact that the company is now prepared to enter into negotiations for the working and maintenance of approved tram lines equipped with self-contained electric cars. The terms under which such working and maintenance could be contracted for necessarily vary with local conditions, but the maximum charge would be 66 per cent. of the gross traffic receipts. This circular is considered by the company to be the best possible answer to the criticism which has lately been made on the expense for upkeep of batteries and electrical gear of tramcars. Mr. F. King, the manager of the company, explains, further, that the above working proposals cover the supply of drivers, conductors, engineering staff and supervision, coals, repairs of steam engines and dynamos and of machinery on cars, and maintenance of the batteries in satisfactory working order; but the company would not provide any capital expenditure for the first supply of batteries. It is not clear who will provide the steam engines and dynamos; but we assume that this item will be borne by the electrical company. Nevertheless, we imagine that the circular will not induce greater confidence in the minds of tramway directors and managers in storage battery cars. In most cases the transfer of horse lines to an electrical company to be worked on the self-contained system, at the rate of a maximum of 66 per cent. of the traffic receipts, would mean a loss to the contractors; in a few other cases expenses might just be covered, whilst at lower than the percentage in question there must be a serious loss. On the other hand, it is fair to suppose that a tramway company, even if it had the money to spare, would not go to the expense of purchasing a number of batteries so as to allow an electrical company to make tests. Tramway companies, generally speaking, have no spare capital for such experiments, and it appears only to remain for electrical engineers to get financed so as to equip cars and depôts entirely on their own account.

New Torpedo Boats.

THE new torpedo boats ordered by the Government to be immediately constructed, although forming a very desirable addition to our navy, leave much to be desired so far as the most essential attribute of such craft—speed—is concerned. Two classes of vessels are to be built, the first of which comprise a set of ten torpedo boats each 140ft. in length and 14ft. 6in. in breadth. These boats are to have a guaranteed speed, with a load of about 25 tons, of 23 knots. The remaining four vessels, which are described as "division boats," are to be 180ft. in length and 18ft. 6in. in breadth, with an anticipated speed of 27 knots, or just over 31 statute miles an hour. Compared with similar vessels in the French and German navies, the capabilities of the four last-named boats are seen to advantage, as they will exceed any similar vessel afloat in regard to speed, while, as they are very little larger than some torpedo boats, they will offer scarcely any more conspicuous target to projectiles or torpedoes. The speed of the first class of boats is, however, much below that of several similar vessels possessed by foreign navies. Thus Schichaus' "Adler" class of torpedo boat, with a length of 152ft. 6in. and a breadth of 16·7ft., has attained a speed of 27·4 knots, or nearly 4½ knots in excess of the projected British vessels. As is well known, also, Messrs. Thornycroft's "Ariete" class—135ft. by 14ft.—have attained a speed of 25 knots, while Messrs. Yarrow's "Pimedo" class—130ft. by 13·6ft.—have reached 24·4 knots, so that it will be evident our new boats are disappointing in this particular. Messrs. Yarrow, of Poplar, are building three of the ten torpedo boats; Messrs. Thornycroft, of Chiswick, three; Mr. S. White, of Cowes, three; and Messrs. Laird, of Birkenhead, one. Of the larger vessels, two are being built by Messrs. Yarrow, and two by Messrs. Thornycroft.

A Combined Conduit.

WHAT seems to be a novel, and at the same time valuable system of electric traction, is described by Mr. R. J. Hewett, an American electrical engineer. The method, which has been worked out by this engineer, has not yet been practically tried, but its merits commend it to consideration. It is essentially a combined conduit and trolley system, the former being, of course, intended for use in large towns, and the latter for operation in conjunction with it in the suburbs and open country. The conduit does not differ materially from those already described in this journal. The current is collected through the slot by means of a trolley roller running on the conductor, the trolley roller being mounted on one end of a lever, the other end being attached by means of a fulcrum to a rectangular frame connected to the frame of the truck through the slot. The whole of this arrangement forms a trolley frame or carrier which is flexibly connected to the truck frame, and guided entirely by the slot. It may here be mentioned that the current is furnished to this part of the line by means of an underground feed-wire laid at the time when the conduit is made, and is in connection with the overhead trolley in the suburb or open, as the case may be. Now, supposing it be desired to change the car, on arriving at the outer end of the conduit, from the underground to the overhead trolley system, it is only necessary to withdraw two pins from guides, to pull out a spring snap connection, and to block the trolley frame fast to the metals. The frame slips out of the guides, and drops on the line, when it can be connected again to the next incoming car in the reverse manner. The ordinary trolley arm is then quickly mounted on the car, and the moment the trolley wheel touches the overhead trolley wire the car is ready to proceed. The frame left on the track is rapidly taken up by the next homeward-bound car, and offers, in any case, no material obstruction to traffic. The details have been well thought out, and there is little doubt that the system will soon be put into practical operation.

Improved Portable Grain Elevator.

AN improved type of portable grain elevator is now being used at the Waterloo Dock, Liverpool, which, it is asserted, is under favourable conditions capable of discharging 140 tons of grain per hour. A few days ago, in actual working, 250 tons of wheat were lifted in 2¼ hours—a rate which, it is said, has never been equalled by either a portable or a fixed elevator. The machinery is of an entirely new type so far as the "leg" portion is concerned, the buckets being tipped in the middle of their journey upwards, a pair of rollers being so placed as to cause the buckets to reverse and deliver to the conveyors while travelling around the leg. By the ordinary elevator the grain is carried to the top of the leg, and there delivered to the conveyors; but this new arrangement is more advantageous, both in lessening the distance carried and preventing the grain from being scattered and lost in transit. As the rate of discharge hitherto attained, even on the fixed elevators, has, it is asserted, only been from 80 to 90 tons an hour, it will be seen that a considerable improvement has been effected.

State of the Skilled Labour Market.

THE following memorandum has been prepared for the "Board of Trade Journal" by the Labour Correspondent to the Board of Trade:—

During the past month there has been a sensible decrease in the demand for skilled workmen. Nor can it be said that the falling off is confined to any special branches of trade. The returns sent in by the chief trade unions show that in every case there is an increase in the number of unemployed members upon the books of such societies. Since the middle of last year the labour market has slowly but surely indicated the progress of a period of trade depression, but in no month during the whole of that time has the change for the worse been so strongly marked as during the month just passed away.

It is fortunate that this transition has thus taken place by easy stages up till now, so that large bodies of men have not been thrown on to the market with the suddenness noticeable in the case of some former depressions.

Owing doubtless to the slackness of trade, of which the unfavourable nature of the month's unemployed returns furnishes so strong an indication, there have recently been many movements to reduce wages or otherwise render the conditions of labour more difficult for the employed. In consequence there has been a considerable increase in the number of strikes noted. Thus, whilst in August the number of such disputes recorded had fallen so low as 35, it has again gone up so high as 54 for the past month. Of these, the coal-mining industry has furnished 14, engineering and shipbuilding are answerable for 8, the textile trades for 7, the clothing trades for 4, and the remainder are distributed over other employments. The numbers of persons involved are not, however, large in the aggregate.

In all, 22 trade unions have sent in returns as to the number of their unemployed members. They show a total membership of 268,674. Of these, not less than 16,794 are shown to be out of work, a proportion of 6·25 per cent., a figure higher than any reported since the beginning of 1888, just as trade was entering upon a period of revival. In August the percentage was 5·02, so that there are nearly 1·25 per cent. more men out of work than there were two months ago. The building trades are still in the most favourable condition, as they have been all through the year, but even they are showing signs of falling away, their proportion of men out of work having gone up from 1·8 to 2·31. The greatest change, however, is that which has come upon the shipbuilding, engineering, and other related trades, amongst which the proportion of those out of work varies from 3 to 10 per cent., although possibly some portion of this may be due to the strikes now pending in various shipbuilding and engineering centres. The textile, clothing, and printing trades are also very dull, and in no case are there any hopeful indications for the coming winter. The general remarks made by the several societies reporting show that two consider trade to be "good," nine consider it "moderate," but eleven report it as "bad."

THE number of ele[illegible] lighted from central sta[illegible] having an actual horse-po[illegible]

MESSRS. MAXWELL AND [illegible] for the Blackpool Tower, [illegible] the tower legs are now ere[illegible] 55ft., and a third [illegible] [illegible]

Machine Construction.

THE CONSTRUCTION OF MACHINE ELEMENTS.

(*Continued from page* 130.

§ 140.

MODIFIED RIBBED AXLE.

FOR heavily-loaded axles the form shown in Fig. 416 is suitable, the ribs being provided with flanges along the edge. Fairbairn has used such axles for water wheels, and Rieter and Co., of Winterthur, have made them for the same purpose. The proportions are determined by taking the

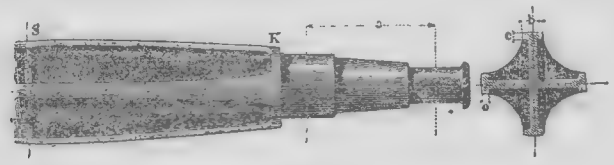

FIG. 416.

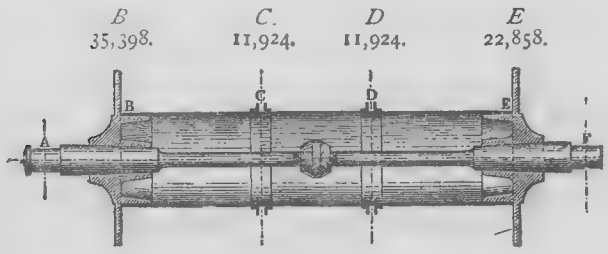

FIG. 417.

diameter y of an ideal shaft of circular section, and calculating h as before. We may then make the flange thickness $c = b$, the thickness of the ribs, and then the flange breadth b_1 is obtained from the formula :—

$$\frac{b_1}{b} - 1 + \frac{\frac{3\pi}{16}\left(\frac{y}{h}\right)^3 - \frac{b}{h} - \left(\frac{b}{h}\right)^3}{6\left(\frac{b}{h}\right)^2 - 1 - 2\left(\frac{b}{h}\right)^3} \quad \ldots\ldots\ldots\ldots (128)$$

This was made to replace a broken axle of wrought iron, for a wheel 32·8ft. (10m.) diameter, 19·68ft. (6m.) in width.* The load is carried at four points as shown, giving a total of 82,104lb.† The shaft consists of a drum of sheet iron $\frac{3}{8}$in. thick and 44in. outside diameter, made in three sections riveted to the central spiders of the wheel. The two journals are fitted to the cast-iron heads with a slight taper, the ends being prolonged into the middle of the drum, where they are drawn together by a right and left-hand nut. The journals are $7\frac{3}{8}$in. diameter and 11in. long. The circumferential joints in the drum are strengthened by pieces of angle iron, as shown. The stress in the shell of the drum is only 3100lb., and on the riveting about 6400lb.

§ 142.

CONSTRUCTION OF RIB PROFILES.

In drawing the curved outline of ribs such as shown in the preceding designs, the following methods may be employed. In the various diagrams shown, A B is the geometric axis of the piece, S the highest point of the curve, and K the lowest point, these both being already determined.

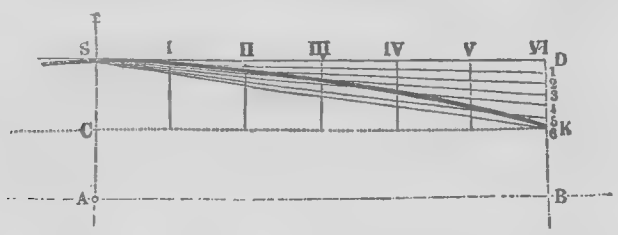

FIG. 418.

from which the following table has been calculated :—

VALUE OF $\frac{b_1}{b}$ WHEN $\frac{h}{y}$.

$\frac{b}{h}$	1·10	1·20	1·30	1·40	1·50	1·60	1·70	1·80	1·90	2·00
0·05	—	—	—	—	—	7·94	6·17	4·81	3·64	2·75
0·06	—	—	—	—	6·99	5·38	4·13	3·17	2·34	1·07
0·07	—	—	—	6·70	5·12	3·91	3·45	2·24	1·61	1·01
0·08	—	—	6·82	5·16	3·91	3·45	2·24	1·61	1·17	—
0·09	—	—	5·45	4·11	3·10	2·33	1·73	1·01	—	—
0·10	—	6·00	4·48	3·37	2·53	1·89	1·39	—	—	—
0·11	—	5·05	3·77	2·82	2·11	1·57	1·15	—	—	—
0·12	6·56	4·34	3·23	2·42	1·80	1·34	—	—	—	—
0·13	5·73	3·78	2·81	2·10	1·56	1·15	—	—	—	—
0·14	5·06	3·34	2·48	1·85	1·33	1·01	—	—	—	—

The ratio between b_1 and b is never made greater than 6 to 7, and as it does not fall below unity the table is only given between these limits. The profile is determined for a few points, and these are joined by a continuous line.

§ 141.

COMPOUND AXLES FOR WATER WHEELS.

In Fig. 417 is shown an axle for a water wheel, made of cast and wrought iron.

1. *Circular Arc.*—This can only be used to advantage when on such a small scale that it can be drawn with compasses or trammel.

2. *Parabola* (Fig. 418).—Draw S D and C K parallel to A B, divide S D into any number of equal parts—as, for example, six parts,—and divide D K into the same number. Drop perpendiculars from I., II., III., etc., join the lines S 1, S 2, S 3, etc., and the intersections of these with the perpendiculars I., II., III., etc., will be joints in the parabola.

3. *Sinoide* (Fig. 419).—Draw S D and C K parallel to A B ; with a radius A S draw a circle about A ; divide the arc S E, cut off between S D and C K into six, or any number of parts ; draw from the points of division, lines parallel to A B, and from I., II., III., etc., perpendiculars to A B, and the intersections will give points in the sinoide.

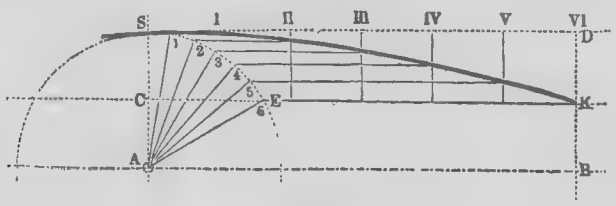

FIG. 419.

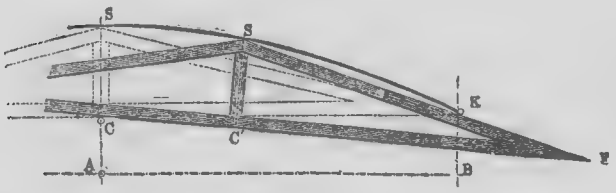

FIG. 420.

* This wheel belongs to the Societé des Eaux du Rhone, at Geneva. See Annales du Genie Civil, 1865 and 1872.

† See diagram in Fig. 409, where the loads are in this proportion,

4. *Elastic Line.*—By bending an elastic rod of uniform prismatic cross section, keeping it upon the points K_1, S, and K_2, the elastic curve may be drawn directly from the rod, using it as a ruler. For large sizes the rod may be $\frac{3}{4}$in. to 1$\frac{1}{4}$in. thick, and kept under water ; for smaller sizes, about $\frac{1}{4}$in. thick is sufficient.

5. *Cardiode.* — The following method may be used for drawing the curve directly in the pattern loft :—A wooden template S′ K E C (Fig. 420) is made, in which E C and E S′ are straight edges, and C′ S″ = C S, and C E = C K. Guide points are placed at C and K, the edge C E kept against the point C, and the edge S′ E against the point K. The point S′ of the template will then describe a cardiode curve, and by attaching a pencil point at S′ it may be drawn directly for pattern makers' use.

The most convenient method in practice is to obtain a few points by (2) or (3), and then join them by a flexible spline or ruler.

§ 143.

WOODEN AXLES.

For some water wheels axles of oak are still used, and these are made polygonal in section. They are made prismatic, the diameter being at all points equal to that necessary at the point of greatest stress, and the methods of attaching journals are shown in § 102. The diameter may be obtained by multiplying the diameter for cast iron by 1·55 (the cube root of the ratio of the modulus of cast iron and oak).

This must be the full actual diameter, as it is sometimes weakened by mortises cut for the arms of the wheel. Should this give a less diameter than required for the attachment of the journals, the diameter at the latter point must be taken for the whole axle. The choice between iron and wooden axles must be governed entirely by local reasons of cost and convenience.

Example.—A water-wheel axle with shanks 106·25in. long is loaded so that the journals of cast iron require to be 3$\frac{1}{2}$in. diameter and 5$\frac{1}{2}$in. long. According to the formula in § 130, we have

$$D = 3{\cdot}5\sqrt[3]{\frac{106{\cdot}25}{2{\cdot}625}} = 12\text{in.}$$

For corresponding strength in wood, the axle should be at a minimum :

$$D' = 12 \times 1{\cdot}55 = 18{\cdot}61\text{in.}$$

(*To be continued.*)

Testing and Analysis of Iron and Steel.—XII.

BY MESSRS. LEADBEATER AND HODGSON (*Analytical Chemists*).

[ALL RIGHTS RESERVED.]

DURING the combustion the tube must be examined from time to time in order to see that it is kept properly heated. When it is seen that all the black is burnt off the asbestos it may be judged that the carbon has been consumed. The time necessary is usually about an hour, but it of course varies considerably, according to the amount of carbon contained in the iron.

When all the carbon is burnt away, the gas flames must be gradually lowered to reduce the heat of the tube slowly, otherwise fracture may occur. The full pressure of gas from the holder must, however, be kept up, otherwise the cooling tube will suck air backwards through the potash bulbs. When all redness has disappeared, the holder may be disconnected and air sucked through the tube to cool it, and at the same time sweep the last traces of carbonic anhydride into the potash bulbs. Any traces of CO_2 or moisture which may be in the atmosphere will be removed by the potash bulbs used for the purification of the oxygen, so that there is no possibility of them entering and being weighed along with the bulbs at the other end of the tube. When the whole has thoroughly cooled, the bulbs G and H are disconnected and immediately fitted with their proper india-rubber tube stoppers to exclude air. They are then carefully dried and dusted externally with a silk handkerchief, care being taken not to touch them with the bare finger. When dusted they are best placed inside the balance case until they assume an equal temperature, after which they should be most carefully weighed and their exact weights entered in the note-book. The percentage of total carbon may then be calculated.

As the amount of pig iron assumed to be taken for analysis was in this case 1grm. (page 3, vol. xii.), the figures should appear in the note-book as follow :—

	Grms.
Pig iron taken : 1·0000grm.	
Weight of bulbs G before....	45·8778
,, ,, ,, after	45·7722
Increase	0·1056
Weight of bulbs H before....	54·3111
,, ,, ,, after	54·3001
Increase	0·0110

Total increase in weight of both bulbs due to carbonic anhydride absorbed = 0·1056 + 0·0110 = 0·1166, which is the amount of CO_2 generated by the combustion of all the carbon contained in 1grm. of the iron. The formula for the combustion of carbon is as follows :—$C + 20 = CO_2$. Adding up the atomic weights as taken from the table we get 12 + 32 = 44, so that we see that for every 44grms. of CO_2 produced we require 12grms. of carbon to produce it. We can now readily calculate the amount of carbon which has been used in producing the 0·1166grm. of CO_2 found in the potash bulbs :—

$$\frac{0{\cdot}1166 \times 3}{11} \quad 0{\cdot}0318.$$

So that 0·0318grm. is the amount contained in this particular sample of iron ; the percentage is then found in the usual way :—

$$\frac{0{\cdot}0318 \times 100}{1} = 3{\cdot}180\%.$$

Another method of dry combustion consists in burning the iron direct in a stream

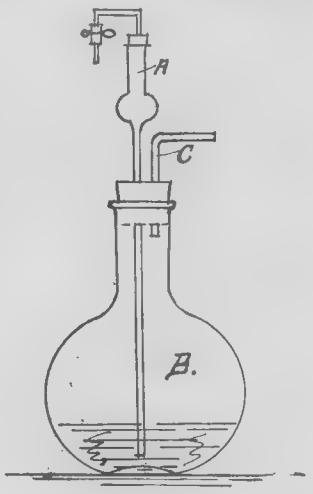

FIG. 34.

amount of CO_2 generated by the combustion of all the carbon contained in 1grm. of the iron. The formula for the combustion of carbon is as follows :—$C + 20 = CO_2$. Adding up the atomic weights as taken from the table we get $12 + 32 = 44$, so that we see that for every 44grms. of CO_2 produced we require 12grms. of carbon to produce it. We can now readily calculate the amount of carbon which has been used in producing the 0·1166grm. of CO_2 found in the potash bulbs :—

$$\frac{0{\cdot}1166 \times 3}{11} \quad 0{\cdot}0318.$$

So that 0·0318grm. is the amount contained in this particular sample of iron ; the percentage is then found in the usual way :—

$$\frac{0{\cdot}0318 \times 100}{1} = 3{\cdot}180\%.$$

Another method of dry combustion consists in burning the iron direct in a stream of oxygen. The sample must be brought to the finest possible state of division by filing and powdering in an agate or steel mortar. It is then introduced into a small platinum boat and placed in the combustion tube, which is fitted up in every way similar to that before described, with the exception that it contains no copper oxide or asbestos. The process, which occupies a very long time, is finished when the potash bulbs cease to gain weight.

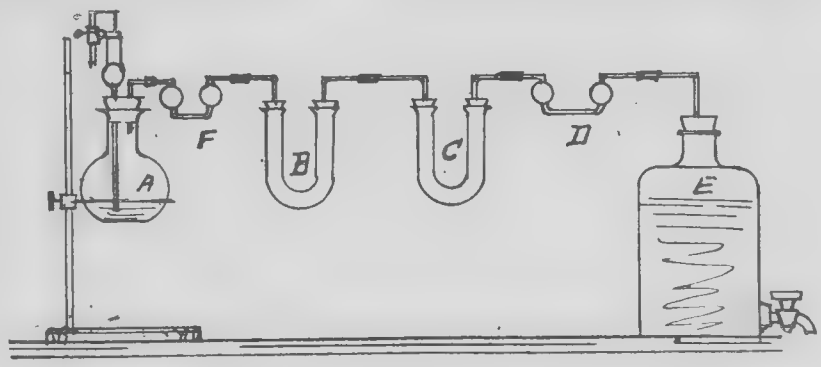

FIG. 35.

The Moist Combustion Process.—By this process, instead of the carbon being consumed by oxygen, assisted by heat, it is oxidised by means of chromic and sulphuric acids. If care be not taken, however, small amounts of carburetted hydrogen are evolved along with the carbonic anhydride.

The iron should be in the form of drillings or in coarse powder, and about 1grm. weighed out for the determination and introduced into a small beaker. For every

gramme of iron taken for analysis, 5grms. of copper sulphate are added to the beaker, and about 20 to 25 cubic centimetres of water, which must, however, be kept as low as possible. Heat may be applied to facilitate the solution of the iron; and the copper will of course be precipitated at the same time in a coarse red powder. The solution should be gently stirred round by moving the beaker, and then allowed to settle. As much of the liquid as possible is then poured off, and all the solid portion rinsed into a flask of about 6oz. or 7oz. capacity (Fig. 34), using as little water as possible, as the success of the subsequent operation depends upon the degree of concentration of the solution. If the liquid in the flask now exceeds 20 or 25 cubic centimetres, it must be evaporated down to that amount, and then thoroughly cooled. 20 cubic centimetres of concentrated sulphuric acid are now added, and the flask placed in cold water to cool. An india-rubber stopper should now be fitted with two tubes, as shown in Fig. 34, the one bent at right angles and just passing through the cork on the inside; while the other passes to within ½in. of the bottom of the flask, and has a calcium tube at its other end. A little piece of cotton wool is placed at the bottom of the bulb, and it is then filled up with potash pumice. Another cork fitted with a bent tube and an indiarubber pinch-cock valve is then inserted, as shown. The flask is then connected to the train of bulbs, shown in Fig. 35, which are supported on suitable stands. A (Fig. 35) represents the flask just mentioned, with a Bunsen burner underneath; it is connected by a rubber tube to the small bulbs F, which are just filled up to the bottom of the bulbs with strong sulphuric acid. The first portion of the tube B is filled with pumice saturated with a strong solution of copper sulphate, and dried thoroughly; the latter half is filled with calcium chloride in small lumps. The tube C is filled with potash pumice in an exactly similar manner to the absorption tubes used in the dry-combustion process. E is the aspirator, and the tube D is filled with sulphuric acid up to the bottom of the bulbs.

The tube B is to absorb acid fumes and moisture. As the calcium chloride is occasionally slightly alkaline, it is well to aspirate air through so that the traces of carbonic acid contained in it may neutralise it. The tube C is the one in which the carbonic anhydride produced by the combustion of the carbon is absorbed; it must therefore be carefully dried and weighed just before commencing the combustion.

When all is ready and the flask cooled after the addition of the sulphuric acid, 4 or 5grms. of chromic acid are added and the stopper inserted in the flask, after which the several pieces of apparatus are connected with tube and string. The aspirator cock is opened to ascertain that all the joints are tight. A little water will of course run out even if they are tight, owing to the reduction of pressure in the tubes due to the weight of the water; but with sound connections it will eventually cease.

Heat may now be gradually applied and regulated so as to maintain a constant flow of gas through the first acid bulbs F. As the current slackens the heat must be increased slightly and continued until white fumes commence to be evolved. The pinch cock at the top of the long tube must now be opened and the lamp may be removed.

Several litres of air must be drawn through the apparatus, the flask being shaken occasionally to disengage any traces of carbonic anhydride which may be retained in solution. The tube C may then be removed and weighed, after replacing the stoppers and carefully drying the whole.

The increase in weight is, of course, due to carbonic anhydride absorbed, and the percentage contained in the iron is calculated in an exactly similar manner to the last example.

These two — the wet and dry-combustion — methods are the two most generally used. Various complicated methods, applicable in special cases, such as with ferro chrome, etc, may be described later.

DETERMINATION OF GRAPHITIC CARBON.

This is the carbon which exists mechanically mixed with the iron and wholly uncombined, so that any method by which the iron may be dissolved away, leaving the carbon behind, is applicable to its determination.

Hydrochloric acid is the usual solvent. Its action in dissolving the iron differs from that of the various copper solutions previously described, in that it attacks the carbon existing in a combined state, and combines with it, forming various carbohydrates; while the chlorine, previously combined with the hydrogen, unites with the iron, and thus leaves only the free carbon untouched. If the iron contains silicon, of course silica is left behind after treatment with hydrochloric acid; but as the carbon is weighed by difference, it is, of course, immaterial, and we can determine the amount of silicon at the time from the same weighed sample of iron.

(To be continued.)

Newcastle-on-Tyne Engineering Students' Club.

THE annual business meeting of the above club was held at the Durham College of Science, Newcastle, on the evening of Thursday, 13th October. Mr. A. E. Heming occupied the chair. The annual report for the past year was read by the secretary, in which he stated that the club, now entering on its sixth year, was still progressing favourably in its endeavour to bring together the engineering pupils from the many large factories on Tyneside for their social and intellectual welfare. The financial report was also read, proving the club to be in a most satisfactory condition. A proposal by Prof. Weighton to amalgamate with the North-east Coast Institute of Engineers and Shipbuilders was considered. The members present were, however, almost unanimously agreed upon continuing as the Engineering Students' Club. The officers for the coming year were then elected, and a vote of thanks to the retiring officials was carried unanimously. The secretary then responded. The usual vote of thanks to the chair terminated the meeting.

MEM. FOR ADVERTISERS.—The charges for advertisements in THE MECHANICAL WORLD are less than half those of any other engineering journal in proportion to circulation, and not one-eighth the price of some of its competitors.

The Design and Construction of Stationary Engines.

XXXVIII.

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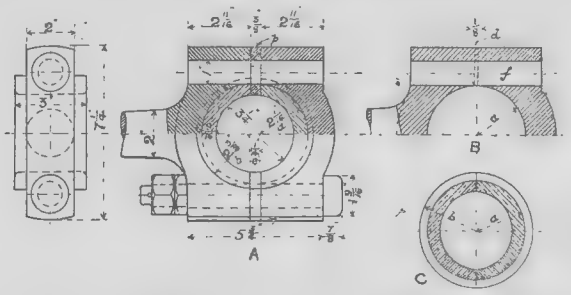
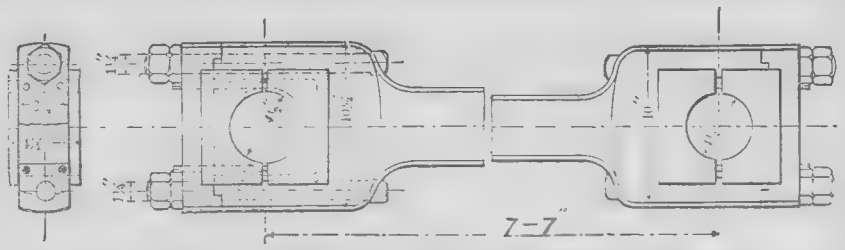
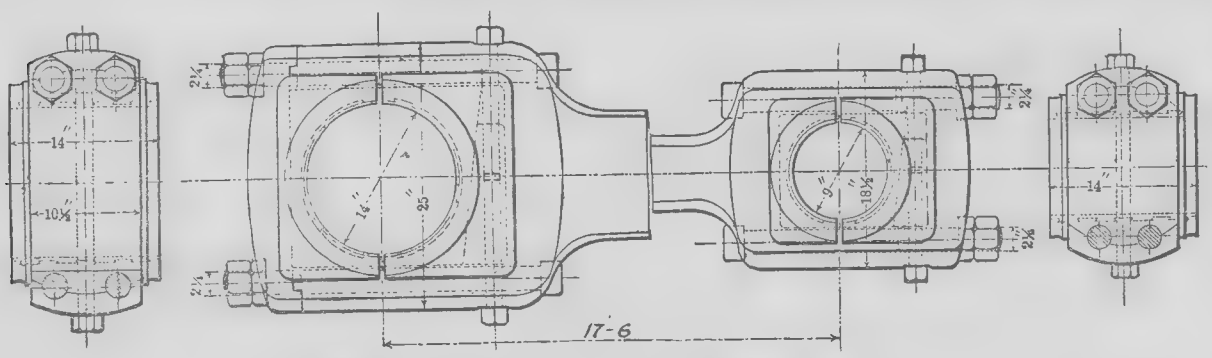
FIG. 183 shows a rod end of this type for a small inverted cylinder engine, the crank pin being 3¼in. diameter by 3in. long, in which the brasses are made somewhat differently, and which offers a very neat and simple way of making a good sound job. The writer has adopted this plan for a number of engines with success. One great advantage is that there being no projections or flats to interfere with the turning up of the brass shells, the whole of the operations involved can be effected by machine tools, thus lessening the cost in fitting very considerably, and ensuring more accurate work. The rod end is forged solid, as at B, with a centre hole forged in. After the rod end and body have been turned, the sides are planed and the hole for the brasses drilled out to the required size, as at B, and then the holes *f* for the cap bolts are drilled through. The bush C is made in halves, and thickest in the middle — in the line of the axis of the rod,—soldered together and turned on the outside to fit the hole in B, the outside flange being turned concentric with it, and made to suit width of rod end. The brasses are now detached and cleaned up, the rod end parted through, as shown in dotted lines at B, by a thin parting tool, and the brasses fitted into place. The brasses are then bored out in their place to suit the crankpin, and the rod end is complete, as shown at A. The thickness of the packing piece *p* is equal to the distance *e* between the centres, plus the thickness of the cut *d* made in parting. To take up wear in the brasses, the packing piece is thinned the required amount until the bush becomes too thin to withstand the pressure on it, when new bushes will be required. Figs. 184 and 185 show two American modifications of this form of rod, Fig. 185 with adjusting blocks behind the steps, one in front in the one end and the other behind in the other end. The blocks are adjusted by two screws entered from each side of the rod, the ends of which nearly meet in the centre. By this means one screw acts as a lock to the other. The steps are shown also lined with white metal, a common practice with large rods, more especially in American and in marine practice.



DESIGN AND CONSTRUCTION OF STIONARY ENGINES.—FIG. 183.



DESIGN AND CONSTRUCTION OF STATIONARY ENGINES.—FIG. 184.



DESIGN AND CONSTRUCTION OF STATIONARY ENGINES.—FIG. 185.

(To be continued.)

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THE true test of value to advertisers is the number of copies paid for, because if a journal is worth paying for, it is read.

Sugar-making Machinery.

XXI.

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A LOADING of 1500lb. per sq. in. applied to the top of a three-roller mill, is found to crush canes satisfactorily; but in one instance was reported to be insufficient to deal with "diffusion slices"—namely, slices of cane out of which the juice has been almost wholly extracted by steeping. It is interesting to notice that, although the 1500lb. per sq. in. of bearing is in excess of the safe limit of 1200lb. given by Rankine, the bearings do not give any trouble under it in practice. This loading of 1500lb. per sq. in. of bearing works out to a very large total load. Take as an instance a 34in. by 78in. top roller, having journals 16in. diameter by 18in. length. The load on each journal would be 193 tons, or 386 tons on the two. Such a roller would be driven at about two revolutions per minute by an engine capable of exerting some 1200I.H.P., and provided with a heavy fly-wheel. This is 100I.H.P. per revolution, and if we compare it with a steamer's screw shaft transmitting the same power per revolution, equal at 70 revolutions, to 7000I.H.P., we shall find

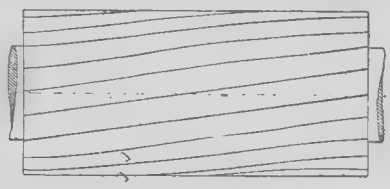

FIG. 39.

that the latter would be made of greater diameter, showing that, even taking torsional strain only into account, the roller shaft is heavily stressed. Longer experience is needed to show whether rollers worked under a load of 1500lb. per square inch of bearing are practically safe against breakage, with either iron or steel shafts; and in recording any case of failure, it will be necessary to ascertain that the rollers had never worked in rigid bearings before application of the appliances limiting the load, in which case the fracture might have been started under the unknown stress due to rigid bearings, and only completed under the probably smaller known load. Of course there must be some degree of loading under which a roller would be, beyond question, safe against breakage; but we must not lose sight of the fact that such safety may easily be too dearly bought at the price of inefficient crushing."

The writer of the foregoing stated that "there is no practical limit to the pressure which it is desirable to put on the canes, other than that due to the limited strength of the mill as a machine." This does not seem to be borne out by other authorities, for Mr. L. Biard, engineering chemist, of Maurice Island, has stated that from numerous experiments which he has made, it is possible to determine accurately the pressure for cane mills, and that the juice decreases

FIGS. 40 AND 41.

in richness as the pressure increases. It is impossible, he says, to obtain the richness of the juice by adopting a fixed coefficient; and this coefficient, he explains, varies with the pressure, and *vice versâ*.

The following is his formula:—

Let C = quantity of sugar in 100kilos. of cane; V = the sugar in 100kilos. of juice; B = the sugar in 100kilos. of begasse; P = the weight of juice recovered from 100kilos. of cane.

$$\text{Then } P = \frac{400C - 266V}{V} \quad \ldots\ldots\ldots(1)$$

$$C = \frac{66{\cdot}50\,V^2 - 91{\cdot}5\,BV}{75\,V - 100\,B} \quad \ldots\ldots\ldots(2)$$

The first formula gives the yield from pressure in proportion to the richness of the canes in juice.

The second formula gives the richness of the cane in proportion to the richness of the juice in the cane and in the begasse.

The results can be calculated in terms of the juice or sugar left in the begasse.

$$P = 100\,\frac{C - B}{V - B} \quad \ldots\ldots\ldots (3)$$

$$C = \frac{66{\cdot}50\,V - 100\,B}{0{\cdot}75\,V - B} \quad \ldots\ldots\ldots (4)$$

Example of formula (2): Let V = 18·5 per cent.; B = 6 per cent.

$$\text{Then } C = \frac{66{\cdot}50 \times 18{\cdot}5^2 - 91{\cdot}5 \times 6 \times 18{\cdot}50}{75 \times 18{\cdot}5 - 100 \times 6} = \frac{66{\cdot}5 \times 349{\cdot}25 - 10,156{\cdot}50}{1387{\cdot}5 - 600}$$

$$= \frac{22,776 - 10,156{\cdot}50}{787{\cdot}5} = \frac{12,619{\cdot}75}{787{\cdot}5} = 16\%.$$

The quantity of sugar in the cane per cent.

Mr. Biard further states that the relative richness of the cane with that of the juice is in proportion to the pressure employed in crushing. The age, kind, and richness of the canes do not seem to have any influence upon this relation. In every case the influence of the pressure is preponderant.

Grooving Rollers.—It is important in making sugar-mill rolls to have them as hard as possible on the surface to prevent undue wear, the hard scaly outer rind of the cane soon polishing the rolls smooth. "The ideal texture for the surface of a roller after being in use is that of granite," but this is impossible of attainment. The rolls must not be "too hard to glaze and refuse to bite the cane." When too smooth the rolls will not drag the cane in. It is customary to turn the cane roll with circumferential serrations of medium coarse pitch—from ¼in. to ½in. pitch. Some prefer to have spiral grooves cut longitudinally, as shown in Fig. 39. Figs. 40 and 41 show cross sections of the grooves to a larger scale; the former are semi-circular, cut with a round nosed tool, and the latter are V-shaped about ⅜in. wide by ¼in. deep. In the more modern five-roller mills the two front rollers are turned with deep V-shaped grooves cut round the circumference about ½in. pitch. Their purpose is to split up the canes and prepare them for the crushing rollers. In the case of rollers which have worn smooth in working, an artificial roughness is sometimes given to them by hacking the face of them with a pick or by hammer and chisel.

(To be continued.)

Shipbuilding Notes.

On the 8th inst., Messrs. Ropner and Son launched a steel screw steamer of the following dimensions:—Length over all, 354ft.; breath, 45ft.; depth moulded, 23ft. 7in. Her triple-expansion engines are by Messrs. Blair and Co., and are of 1500I.H.P., with two large steel boilers, working at 160lb. pressure.

On the 10th inst., the s.s. "Szent Istvan," a steel screw steamer built by Messrs. Wigham Richardson and Co., at their Neptune Works, Newcastle, accomplished a very successful trial trip off the Tyne. She is 285ft. in length by 38ft. beam, and is fitted with triple-expansion engines, which, with the boilers, have also been constructed by Messrs. Wigham Richardson and Co.

Messrs. Caird and Co., Greenock, launched, on the 12th inst., a steel screw steamer of 4300 tons gross, for the P. and O. Company. Dimensions:—Length, 385ft.; breadth, 45ft.; depth, 31ft. The new steamer will be supplied by the builders with triple-expansion engines of 3000I.H.P., the diameter of the cylinders being respectively 28in., 46in., and 77in., with a piston stroke of 4ft. 6in.

The s.s. "Thracian," built by Messrs. S. M'Knight and Co., of Ayr, and engined by Messrs. Muir and Houston, of Glasgow, made her official trial trip on the 10th inst. The steamer is built of steel. The dimensions are 175 by 26 by 11½ft. She is fitted with triple-expansion engines, having cylinders 14in., 23in., and 36in., by 27in. stroke. The steel boiler is 12ft. 9in. diameter, and 10ft. 6in. long. On trial the engines indicated about 650H.P., and a speed of 12½ knots was obtained.

The two new steamers under construction by Messrs. Harland and Wolff at Belfast, for the Union Steamship Company's service to and from South Africa, are in a forward state, and the directors have decided to name them the "Gaul" and "Goth" respectively. A third steamer has been contracted for with the same firm, to be named the "Greek." She is of similar dimensions to the "Gaul" and "Goth"—viz.: Length, 400·7ft.; breadth, 47·2ft.; depth, 26·7ft.; gross tonnage, about 4830; net tonnage, 2123; twin screws, two sets of triple-expansion engines; diameter of cylinders, 18½in., 30in., and 50in.; length of stroke, 22in.; I.H.P. 2000.

The Fairfield Shipbuilding and Engineering Company Limited launched on the 12th inst., from their yard at Govan, a twin screw steamer built to the order of the Commissioners of Northern Lighthouses. The dimensions are:—Length, 175ft.; breadth, 26·6ft.; depth, 14·6ft. She is built throughout of best Siemens-Martin mild steel. Two sets of triple-expansion engines will be fitted on board, each set having three cylinders 14½in., 44in., and 39in. diameter, by 2ft. stroke. The shafting is all of steel, and the propeller blades of manganese bronze. Steam will be supplied from two single-ended cylindrical and tubular boilers, fitted with corrugated furnaces, and working at a pressure of 160lb. to the square inch.

The Electric Transmission of Power.

(Continued from page 145.)

ANOTHER interesting plant is the generating station located at the villa town of Tivoli, Italy, which is situated in the Sabine Hills 18½ miles from Rome. The practically unlimited water-power of the river Amene is used at this point to drive water-wheels. The current generated is utilised for light and power in Rome.

The motive power is derived from a water flow of about 132 cubic ft. under a head of 157ft.

Six turbines of 300H.P. each are coupled direct to alternating dynamos, 230,000 watts capacity, at 170 revolutions a minute.

In addition there are three direct-current machines, each coupled to a turbine making 375 revolutions, which are used as exciters for the alternators.

At full load, a potential of 5100 volts is used. The current is conducted by means of four bare copper wires (between Nos. 7 and 8 B and S gauge), carried on iron poles with oil insulators.

The drop in potential amounts to 20 per cent. on a line of 18·4 miles (circuit 36·8 miles). At the outskirt of Rome, near Porta Pia, is located the distributing tower in which the current is transformed from the pressure of 5000 to one of 2000 volts. This is again reduced at centrally-located points to 100 volts, at which it is furnished customers.

When fully completed, the central station of Rome, with its 5000H.P. capacity, will be the second largest lighting plant of Europe, Berlin having the largest.

The town of Pontresina is situated in the Engadin Valley, at an elevation of some 6000ft. above the sea.

The lighting plant was designed and constructed by the firm of R. Alioth et Cie., of Basle, and is one of the somewhat uncommon direct-current transformer systems.

About 4 miles south of Pontresina, at the base of the famous Morteratsch glacier, are the falls of the Bernina.

A portion of the stream above the falls is diverted to a small reservoir from which it is conveyed by a cast-iron pipe to the power station at the foot of the mountain. It is used to drive the turbines to which the dynamos are coupled.

The maximum rate of water discharge is over 70gals. a second with a head of 420ft.

75H.P. high-pressure turbines, built by Escher, Neyss et Cie., of Zurich, are used, each connected independently to a primary dynamo by flexible couplings. The generators have each a capacity of 34 ampères (1500 volts), or 51,000 watts at 500 revolutions, and are of the four-pole type series wound.

The turbines are equipped with automatic regulators which maintain a constant speed, this ensuring a constant potential at the transforming station under all loads. Three machines are run in series, giving a combined capacity of 34 ampères, 4500 volts, 153,000 watts, a fourth being held in reserve in case of breakage. The primary current is conducted by a No. 4 copper wire. Oil insulators are used.

In the transforming station, situated in the centre of Pontresina, the current passes first through meters and safety devices placed on the switchboard, then to the four motor dynamos which are connected in series, the secondary lines being connected in multiple with the service lines.

The number of transformers at work is controlled by a multipole switch, the number running corresponding to the number of generators in operation.

The difference in the construction of the "direct-current transformer" or "motor dynamo" from the ordinary dynamo, consists in the presence of two distinct windings on the armature, each connected to a separate commutator located at the two extremes. Through one set of windings the primary current is passed, causing the armature to revolve, producing the motor action, while in the other a current is generated and conveyed to the service line, the voltage of this latter depending on the same conditions that govern any dynamo.

The current of the secondary, which delivers 280 ampères at 130 volts, is distributed by a second switchboard, fully equipped with all the necessary regulating apparatus, meters, and safety devices.

One hundred and twenty arc lamps are used, and the greatest load is 840 ampères at 130 volts. Over 1700 incandescent lamps of different candle-power are on the circuit, besides the arc lamps used for street lighting.

Streets, hotels, and private houses are lighted. The plant was erected by the consumers, and is run on the co-operative plan. Every citizen can join by paying his actual part of the expense. The company is in touch with the township from which it derives its water-power rights, and in return it furnishes the street lighting free.

In spite of the distance between the power station and the point of consumption—four miles,—the direct-current system was adopted on account of its safety and the many advantages it afforded in making it possible to add accumulators to the system, thus increasing the capacity at the heavy period of consumption, and also its greater adaptability for motor service.

A rather novel plant is being constructed at Kioto, Japan. In this case the water of a lake some nine or ten miles distant from the city will be brought through pipes to a distance of about two miles from the city limits. Here it will be used to drive electric generators. The power will be used throughout the city for factories and for general lighting and power work. The motors farthest from the generating station will be some four miles distant. Pelton waterwheels of 120H.P. are to be utilised.

It is estimated that there are fully 200 power stations operated by water-power in Switzerland alone. Even in the "Dark Continent" of Africa they have long-distance electric-power transmission plants. The Forbes Cliff Mining Company, in the Transvaal, operate Pelton waterwheels coupled direct to Edison dynamos, aggregating over 200H.P., which is transmitted four miles. The efficiency of the entire system is over 70 per cent.

At St. Brieux, Côtes de Nord, France, two 1300-light Thomson-Houston alternators are driven by two Hercules turbines of the vertical type, one a 125H.P. and the other 150H.P. An interesting characteristic of this plant is that the alternators are run in multiple upon the same circuit. The distance from the central station to the centre of distribution is some eight and one-half miles, and the pressure employed 2000 volts. It is interesting to note that the wires used to convey the current for 2600 16C.P. incandescent lamps over the distance of eight and one-half miles, are 0·31 of an inch in diameter.

A power-transmission plant at Ayonnax, Eastern France, has been in operation since March, 1890. Power is obtained from a 1750H.P. fall, five miles from town, where two 105-kilowatt machines are coupled direct to two horizontal turbines. Current is transmitted on the three-wire system to two 120H.P. motors, driving directly two 125-volt 600-ampère dynamos. The commercial efficiency is said to be 76·2 per cent.

The power of the 180ft. fall at St. Lorenzen, Austria, will be utilised for running the works of the Franz Company, of Marburg, 18 miles distant. Of the 600H.P. available, it is expected to utilise about 450 at the works. Total cost of plant estimated at about $110,000.

An Anglo-Swiss syndicate has been formed to utilise the power of the Rhine at Laufenberg for the electrical transmission of power. It is intended to make a canal one mile long, and it is estimated that some 7000H.P. will be available.

The 45,000-light station at Paris, supplying the Place Clichy sector, has three floors, with a superficial area of 19,800sq. ft. Three 150H.P. Armington and Sims engines belted to two shunt-wound dynamos, and three 500H.P. Corliss engines running at 64 revolutions, and coupled direct to 350 kilowatt (700 ampère, 500 volts) eight-pole machines, armatures 11ft. in diameter, run during the day; a 250-cell battery of Laurent-Cely accumulators supplies current during the night. The district has an area of nearly two square miles.

In Guatemala, Central America, a combined arc and incandescent plant has been operated by water-power since the year 1887. Part of the plant consists of two Thomson-Houston 1500-light alternators. The station is 3¾ miles distant from the city. Twenty-one inch Rodney-Hunt turbines of 250H.P. are used, driving the dynamos by a countershafting. The remainder of the plant comprises seven 45-light 2000C.P. arc dynamos, and three 18-light machines. This part of the plant is 7½ miles away, and receives its power from a 15in. double Rodney-Hunt turbine of 260H.P.

(To be continued.)

THE presence of gold in the country between the Upper Irrawaddy and the Chinese frontier is announced by the Indian Geological Survey. The metal is said to be found in recent deposits throughout the district, and is washed for by the natives in a very primitive manner. It is added that there seems to be a decidedly more favourable prospect of a successful "placer" tract being found between Hokat and Watu, on the Irrawaddy, than has yet been discovered in the Indian Empire.

Institute of Marine Engineers.

A MEETING of the Institute of Marine Engineers was held in the premises of the institute, 58, Romford-road, Stratford, on Monday, October 10, when the chair was occupied by Mr. L. P. Coubro, convener of transactions committee. The subject of the evening was entitled "Our Firemen," and was brought before the meeting in a paper written by Mr. E. D. Murphy (member), chief engineer of the "Empress of Japan," and read by the hon. secretary. At the commencement of the paper, attention was called to the fact that as a rule the present system of selecting and engaging firemen is not conducive to the economical working of the boiler. The discharge notes are frequently unreliable, due partly to the careless way in which they are filled up. The system of continuous discharge-books was strongly advocated, and the main points of the paper were generally advocated in the discussion, which was taken part in by Messrs. Sage, Thomson, Wilson, Tyler, the hon. secretary, and others. The following suggestions were made by Mr. Murphy at the conclusion of his paper:—

(1.) The chief engineer should have more personal control over the men—not in any way to usurp the authority of the commander (there can be only one head in a ship, and the commander is naturally that head), but his word should be sufficient for entry into the log, without having to take an offender before the commander and chief officer, causing loss of time and tedious explanations. Surely, if the chief engineer is able to look after the varied types of machinery that are placed under his charge, he can be trusted to control the men who work them; being on the spot and knowing the harm done, he is in a better position than the captain to inflict the fines. How many blackguards get off without any punishment through the deck and engine-room departments not pulling together!

(2.) Renewing the old form of register-ticket, modified, or making the present form of discharges into a book-form, introducing a few additional lines to be filled in by the chief engineer—decidedly never by the purser or steward as at present,—testifying to the character of the man in his capacity, such remarks to be brief and give an idea of his worth—viz.: "good fireman, useful in engine-room"; "very good man, fit for any position"; "good fireman, but not steady in port"; "poor trimmer, joined as a substitute," etc. The discharge being made continuous, we should know that in nearly all cases the man showing it was the rightful owner, and by its examination see where he had been and what he had been doing, his conduct and general ability, and when he was last employed on a steamer. By a judicious use of the remarks on the discharge-book, and using it as the only reference when employing men, all classes of firemen would get to know that they must deserve good references in their respective rating if they were to get work, and it would cause a general brightening up; the bad men would be weeded out, either by changing their manners or seeking other employment. The shipping master should hold the discharge-book after signing, to return the same after the articles are completed. Men not turning up after signing, the shipping master should be empowered to treat them as they deserve before returning the book.

(3.) Making a new class, to be called leading firemen; all ships to have one, large ships to have one on each watch, or more as required. Their pay should be better than the ordinary fireman, and let them be given a few privileges. Other men by good conduct and ability would try to obtain this position; the leading man going in the same ship voyage after voyage would know better than new men the style of firing the boilers required; he could give and see the necessary instructions carried out, and would teach men who are promoted from trimmers the correct method of firing. Under this head, make it necessary for a donkey-man to have a certificate, this certificate being granted and signed by at least two chief engineers, and only to be given after the applicant has had sufficient experience and is capable of understanding what he is in charge of. Some of our modern donkey and auxiliary boilers are of the same scantlings and pressure as the main boilers; they want judicious working and careful treatment; yet a man may be in charge of them who does not know the difference salt water makes in working with a pressure of 160lb. per sq. in. from that of working with 25lb. If he salts up the boiler and brings down the furnace or combustion chamber top, this being marked on his certificate will tend to make him careful to guard against such an occurrence. The donkey-man

should assist the second engineer in engaging the men, as, being a fireman himself, he is in a better position than the second to know the class of men they are dealing with.

(4.) Make the ship more like a home for the men by signing them on for a longer period than one voyage, say six or even twelve months, letting them live on board in the home port, give them their own qualified cooks and a separate room for sailors and firemen, where, after their work is done, they could read papers, yarn, or write a letter. Also let each man have, in addition to his bunk, a good substantial locker with lock and key, to keep his private effects in; in a great number of cases the men cannot take anything besides their working clothes, through the liability of having their personal effects stolen. This means an additional initial expense, but should prove a good investment in the long run. The men, seeing an interest taken in their welfare, and knowing on the return of the ship they will not have to turn out, losing time and money in seeking fresh employment, would settle in the ship, get accustomed to their work, and knowing what is required, would be of far more use than if strangers were employed each time.

(5.) Drunkenness, so prevalent amongst our firemen, should be severely dealt with, and all means taken to crush it out. A man joining under the influence of liquor, getting drunk at sea, or in such a state either at sea or in port as not to be fit for duty, should be punished on the ship's return, not at the first port of call, when the loss of a man may be found very inconvenient.

The hon. secretary announced that he had been present at the second annual dinner of the Bristol Channel Centre, held in the Royal Hotel, Cardiff, and that it had proved a very pleasant reunion.

Pita-flax or Sisal-hemp.*

THE plant from which pita-flax is obtained is a native of South America and the West Indies, but it has been naturalised and become almost indigenous to all countries bordering on the Mediterranean —Algeria, Egypt, Sicily, Spain, and Portugal,—where it is much employed as a boundary hedge for roads and fields. It is a species of aloe with a fibrous root, a very short trunk, large fleshy leaves of a sea-green colour, with prickly edges and pointed ends, from 20in. to 4ft. in length. The leaves increase in size year after year, and usually at the age of 20 or 30 years, but sometimes as early as its eighth year, a tall shaft is thrown up, which in about the space of a fortnight grows to the height of from 23 to 28ft., and produces a flower at the top, but this so exhausts the plant that the effort usually kills it.

It is chiefly in the West Indies and Mexico that it is cultivated for profit. With the exception of the outermost and innermost leaves, of which the first are too coarse and the latter too tender, the rest are cut as near to the root as possible, and on being scraped and beaten with wooden instruments produce a valuable fibre of great strength. That from the exterior leaves is used for cordage and mats, from the intermediate leaves coarse cloths are made, and the inner leaves produce a fine quality of fibre from which delicate tissues are woven resembling fine linen. It is sometimes prepared in Spain of a sufficiently fine texture to be exported to Lyons for mixing with silk fabrics. The Mexican varieties of aloe, called in that country "Maguey," produce not alone a fibre which in France is known as Tampico horsehair, and in England as Mexican grass, pita-flax, or Sisal-hemp, but also a favourite intoxicating beverage (pulque), somewhat resembling perry, which is largely consumed in that country.

Hitherto the recovery of the fibre has in almost all countries been a tedious operation performed by hand, but in Yucatan a considerable trade has been created during the last few years by the application of machinery worked by means of horses or steam. From 5000 to 7000 leaves are daily crushed, and the fibre separated by means of a wheel fitted with metal blades, which revolves in a circular pan, each thousand leaves yielding from 55 to 90lb. weight of dry flax, and in this way the Yucatan production has been raised to an average value of £200,000 per annum. This system, however, is in some ways objectionable, for it occasions a great deal of waste and often injures the attending workmen.

Mr. Berthet, who is already well known as the inventor of useful machinery of a similar kind, has recently introduced a greatly improved apparatus for the purpose which obviates those objections, and will no doubt supersede the older system. His machine is described and illustrated in vol. ix. p. 33, of the "Bulletin de la Société Industrielle de Rouen," and consists of two parts. The leaves are first crushed between fluted rollers, and are then drawn continuously by means of an endless rope to a point where they are made to pass between a curved wooden support and a drum fitted with many blades. This drum in revolving tears away the pulp from the whole length of the leaves and lays bare the fibre, but the operation is again repeated by the position of the leaves being automatically reversed and drawing them through a second drum, which completes the separation of the fibre.

In his work on the "Fibrous Plants of India," Mr. Forbes Royle gives the result of many tests made by him in India of the comparative strength of pita-flax and other fibres. He found it to be 70 per cent. stronger than Russian flax, and also that it has greater resistance than cocoanut fibre. When wet it shrinks 25 per cent. less than ordinary hemp-rope. The British Consul at Aden has also recently reported at some length on the mode of preparation of the fibre in the Somal country.

* Inst. C.E.: Foreign Abstracts.

Spontaneous Combustion.

AT the Philosophical Hall, Leeds, on 10th October, Professor Arnold Lupton delivered his introductory lecture to the series of subjects connected with mining with which he proposes to deal during the coming winter at the Yorkshire College. Mr. J. W. Embleton, Methley, occupied the chair. In the course of his lecture, which was on the subject of "Spontaneous Combustion," Professor Lupton remarked that most of the difficulties of a mine could be overcome in certain well-known ways; water could be raised by pumping engines; gas carried away by ventilation, and the danger obviated by safety lamps; but spontaneous combustion in some cases could not be prevented, and when once begun could not always be stopped, except by filling the pit with water. Spontaneous ignition of coal was well known to shipowners and insurance companies, ships containing large cargoes of coal being especially liable to take fire upon long journeys. In the same way a great heap of coal on the surface was liable to take fire, especially if it was small coal or slack. For that reason it was necessary in storing not to have the heaps too wide or deep. A heap 10ft. deep might not fire, while a heap 20ft. deep of the same coal would be very likely to fire. A small heap of slack laid against the outside of a boiler flue or steam pipe would probably take fire in a short time. Heaps of slack and broken coal left in the mine were very liable to take fire, and much smaller quantities would fire in the mine than on the surface, because it was warmer underground, and the pressure of the superincumbent strata upon the slack and broken coal prevents the heat from escaping. Spontaneous ignition was very frequent in the thick coal mines of South Staffordshire, Warwickshire, and Leicestershire, and it was necessary that these pits should be watched every hour of the day and night lest a fire having broken out should obtain the mastery before it was discovered. If a fire is detected whilst yet smouldering, the heated material should be dug out, if possible, and the space filled with sand. Sometimes the fire was extinguished by pumping water on to it. In some mines water was laid on at a high pressure for the purpose of throwing jets of water on to any fire that may occur. It was usual, however, in mines liable to spontaneous combustion, to separate the district containing the waste heaps of slack or broken coal from the rest of the mine by means of walls or dams of brick and clay and sand, so that the smouldering fire, producing carbonic acid gas, extinguishes itself by its own smoke. Sometimes an apparently solid mass of coal took fire. In this case the apparently solid coal had been cracked and crushed, and air had been able to enter into the cracks to support combustion. In mines liable to this species of accident the manager had a very anxious time, and his deputies had to unceasingly patrol the pit. Sometimes it was impossible to isolate a fire owing to air drawing through cracks in the pillars of coal surrounding the fire, and the men were beaten back by the flames, and had to abandon the mine. The shafts were then partly filled and covered to exclude the air, and in the course of three or four months it generally happened that the fire was extinguished. The cause of these fires was perhaps not entirely explained. It used to be supposed that the decomposition of the sulphate of iron, called pyrites, produced heat sufficient. This idea, however, was now abandoned by the leading chemists who had studied the question. Sir Frederick Abel and Dr. Percy, in a report to the Royal Commission of 1875 on the spontaneous combustion of coal in ships, suggested the decomposition of the coal as the probable cause. Professor Vivian B. Lewes in 1892 contributed a paper to the Society of Arts, in which he stated, as the result of the work of Richters and himself, that newly-cut coal would absorb oxygen to the extent, in some cases, of three times its own volume. This oxygen produced a kind of slow combustion, and where the heat could not escape the temperature of the mine was raised to that of 800° or 900° F., and at this temperature, if there were any air near to the coal, it would take fire. There were only two ways, apparently, of preventing this spontaneous combustion. One was to cool the heap by ventilation. But the ventilation to be efficient must be equal to that of a coal heap on the surface, and it was known that a heap of small coal 20ft. thick and 30 or 40ft. wide was very liable to take fire; therefore, if the heap of coal in a mine was to be cooled by ventilation, the ventilating roads would have to be not much more than 15ft. apart, and a cool current of air through each. This, as a general rule, was impracticable; and therefore, as a general rule, the prevention of spontaneous ignition by ventilation was impracticable. The other method was to exclude the air from the mass of coal that was liable to fire by means of walls of soft clay or barriers composed of mortar and sand, or solid pillars of coal. The portion of the mine so walled off might get very hot, raising the temperature of the mine 10° or 20° above the normal temperature of the earth; but it could not take fire if the air was excluded.

Catalogues, Price Lists, Etc.

Engineers, Tool Makers, Metal Merchants and others are invited to forward Catalogues, Pamphlets, Circulars, Price Lists, etc., for notice in this column.

MESSRS. WATSON, LAIDLAW AND CO., Dundas-street South, Glasgow, have issued a very complete catalogue of the special machinery with the manufacture of which they have for some years been identified. The "Weston" centrifugal machine is shown in all its various applications by a number of exceedingly fine illustrations, each arrangement being accompanied by full particulars of construction, dimensions, output, etc. Sugar-making machinery is well represented in the list, and illustrations and particulars are given of pug mills, sugar mixers, air compressors, conveyors and elevators, pumps, engines, friction clutches, etc. One section of this voluminous work is devoted to a description of the "Victoria" patent testing machine for milk, butter, etc. In the miscellaneous section particulars will be found of swivel bearings, brackets, couplings, pulleys, vacuum pans, heating coils, stop valves, gun-metal cocks, etc. The catalogue is well printed and illustrated, and is in every way a highly creditable production.

Messrs. BURNHAM, WILLIAMS AND CO., of the Baldwin Locomotive Works, Philadelphia, have favoured us with copies of their pamphlets on tests of compound locomotives, and on the methods of conducting them. The first of the particular tests referred to were made in July, 1891, and were for the purpose of comparing two locomotives of the Mogul type, one a simple engine and the other a compound of the four-cylinder type, invented by Mr. S. M. Vauclain, the superintendent of the Baldwin Works. Several other tests are also detailed in the most complete manner, full dimensions of the various engines being given, and also voluminous details of their performances, indicator diagrams, etc. The second pamphlet explains Mr. Vauclain's method of conducting elaborate tests of locomotives, and is very interesting reading. Both publications are remarkably well printed and illustrated, and fully deserve to be preserved in a more permanent form.

The WATERSPOUT ENGINEERING COMPANY, Sydney-street Works, Salford, have issued a neat little pamphlet descriptive of the "Waterspout" patent pulsating steam pump. It is claimed that the Waterspout pump is capable of dealing with almost any kind of liquid, while it requires no skilled attendance, oil, packing, or leathers. Moreover, it has no glands, requires no foundation, and as there is no exhaust steam the pump can be used in confined spaces without overheating them. Full particulars, dimensions, etc., of the various sizes of pumps are given in the catalogue, which in addition contains several illustrations of the apparatus.

Trade Notes.

The directors of the Rio Tinto Copper Company have declared an interim dividend of 7s. per share.

The John Cockerill Engineering Company, of Liège, Belgium, have declared a dividend of 9 per cent.

The contract for the Blackpool electric-lighting station has been placed with Messrs. Hammond and Co., of London.

The Italian Government have placed an order for 20,000 tons of steel rails with the firm of Tardy and Benech, of Savona.

Mr. John Steel, Stirling, has contracted to supply 470yds. of 4in. cast-iron water pipes to the authorities at Killin, Perthshire.

Messrs. Siemens Brothers, London, are supplying the engines and dynamos for the new electric-lighting station at Derby.

Messrs. Hughes and Patterson, of Philadelphia, have commenced to lay the foundations for their new tinplate plant.

Messrs. Charles Cammell and Co., Sheffield, have secured a contract for 8000 tons of rails for the Norwegian State Railways.

Messrs. Leslie and Hall, Glasgow, have secured a large contract for tinplate, sheet copper, etc., from the Glasgow Corporation.

Messrs. Short Brothers, of Sunderland, have received orders for three large passenger and cargo-carrying steamers for local owners.

Messrs. John Fowler and Co., of Leeds, have supplied two steam engines of 250H.P. each for the electric-lighting station at Mexico.

Messrs. George Smith and Co., Phœnix Foundry, Glasgow, have secured an order for fencing, etc., from the Corporation of that city.

Messrs. Clark, Chapman and Co., of Gateshead, have been instructed to install three large oil-carrying steamers with the electric light.

Messrs. Alexander Trinbull and Co., Bishopbriggs, are to supply the screening apparatus and elevators required by the Glasgow Corporation.

The Greenock Foundry Company, Greenock, have completed the engines and boilers for the battleship "Centurion," and have despatched them to Portsmouth.

Messrs. J. G. Statter and Co., Westminster, London, have secured the contract for the electric-lighting installation at the Southampton Corporation Waterworks, at Otterbourne.

The Indian Government have placed an order with Messrs. Yarrow and Co., of Poplar, for the construction of a shallow-draught steamer for service on the upper part of the Chindwin, in Burmah.

All the men employed by the Askham and Mouzell Iron Company, at their ironworks, Askham-in-Furness, numbering about 200, have received notice. It is thought this is with a view to a readjustment of wages.

The owners of the Thames steamer "Koh-i-noor" have placed a contract with the Fairfield Shipbuilding Company, Glasgow, for a duplicate vessel. The Japanese Government have asked Clyde shipbuilders to tender for six steamers.

Messrs. Meredith and McBeath have acquired the Milton Ironworks, West Hartlepool, formerly carried on by Mr. Bowser, St. Neots, but which have been idle for about fourteen years. Nuts and bolts are to be extensively manufactured.

Messrs. D J. Dunlop and Co., Inch Works, Port-Glasgow, have just finished and completed taking down the two large ship caissons built by them for the Kidderpore Docks, Calcutta. The total weight of the two caissons, as shipped, is over 600 tons.

A speciality has lately been made by Messrs. Blakey, Emmott and Co., the well-known electrical engineers in Halifax, of circus lighting. One circus having been fitted with engine and dynamo for arcs and incandescents, the rest have followed suit, and quite a number have been fitted up, with much satisfaction to the proprietors and the public.

It is announced that Messrs. Pascoe Grenfell and Sons Limited, who carry on large copper and smelting works at Swansea, contemplate winding up the affairs of the company. Some 700 people will be affected by the stoppage, but it is expected a syndicate will be formed to carry on the business of the firm. The firm has been in existence for over a century.

Readers of "The Mechanical World" are invited to send to the publisher of "Good Health," the new weekly paper devoted to food, drink, medicine, and sanitation, for a prepaid parcel of specimen copies. Address, 391, Strand, London, or New Bridge-street, Manchester.

Wheel cutter in metal only. Every description of gearing. R. CHIDLAW, 43, City-road, Manchester.

Having regard to the enormous circulation of THE MECHANICAL WORLD, the Editor suggests that it is by far the best medium for the insertion of every kind of "Wanted" advertisement, and the price is only one halfpenny per word. The Editor will be glad if MECHANICAL WORLD readers will kindly bear this in mind as occasion arises.

The Daimler "Petrol" Motor.

THERE seems to be an increasing tendency towards the adoption of oil engines for use on launches, both in this country and abroad. This is probably due to the fact that this class of motor can be started and the boat set in motion in a few minutes by almost anyone of ordinary intelligence, whilst with a steam launch some little time must elapse before steam can be raised. Other advantages are the facility with which the launches can be operated and the compactness of the motors. In this connection it may prove interesting if reference is made to the Daimler petroleum motor, which is now being introduced into this country by Messrs. Simms and Co., of 10, Billiter Buildings, Billiter-street, London, E.C. This motor is the invention of Mr. Daimler, and is the result of nine years' experiments. Although comparatively unknown in England, the motor has gained a high reputation both in Germany and the United States, where it has been adopted for a variety of purposes.

One of the applications of the Daimler motor is for the propulsion of launches, and a few days ago one of our representatives made a trip in a new launch which had just arrived from Germany. This launch is built of oak, and is 30ft. long, 6ft. 6in. wide, with a draught of about 1ft. 6in. The remarkable features of the boat are her lightness and high gunwales, which afford ample support to the back when sitting on the seats arranged round each side of the launch. She is fitted with a 4H P. nominal Daimler motor, which is bolted down aft and covered in with a casing, having doors on each side so as to afford ready access to the motor, which we will now proceed to describe, with the assistance of the accompanying illustrations. Fig. 1 is an end view of a stationary motor, Fig. 2 shows the burner, and Fig. 3 is a longitudinal section of a two cylinder boat motor. It may be mentioned that the oil used is termed "petrol" (rectified petroleum or benzene).

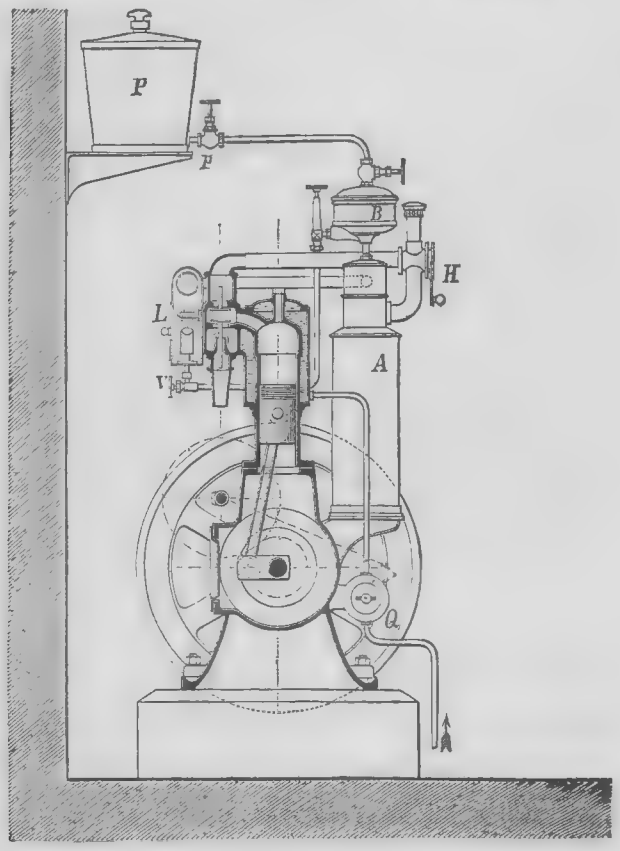

FIG. 1.

Referring to Fig. 1, A is the vaporising chamber in which vapours are generated by means of the suction of heated air through the petrol; a little more air is added through the regulating valve H before entering the cylinder, this producing the proper combustible gas. When the piston descends it draws in some of this gas and air mixture, which is compressed on the return stroke, and the mixture is fired on coming into contact with the red-hot inner end of a hollow platinum percussion cap G at the moment when the piston is at its highest point. The lamp with the cap G is clearly shown in Fig. 2. This cap is kept at a red heat by means of the lamp L. The burning gases in the cylinder expand and give a downward pressure on the piston, the motion being transmitted to the crank in the same manner as obtains with ordinary engines. It will be understood that to set the motor in operation the vaporising chamber A and the lamp supplier B must first be filled with petrol. This is accomplished in stationary motors by opening the valve *p*, when the oil flows from the tank P to the lamp supplier and the vaporising chamber A. An indicator attached to a float is arranged in this chamber, to show the height. In launches, however, the oil is pumped into the two chambers by means of a small hand pump, according as required. Before starting the motor, the lamps for heating the percussion caps G are lighted, after the thumb screw valves at the bottom of the burner have been opened. The burner tube E is previously warmed for about a minute with a spirit lighter so as to cause the development of the gases necessary to produce an effective flame. This flame, both in and above the burner cap F, burns with a roaring sound, and causes the percussion cap to remain red hot. The wicks in the burner are renewed as occasion may arise, and the working cylinders are lubricated by means of drop oil cups, whilst the starting crank, the guides, bearings of the main shaft and steering gear, are also kept well oiled.

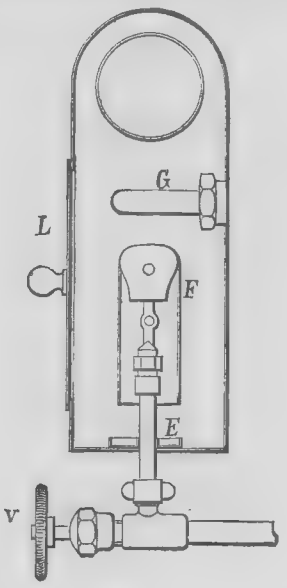

FIG. 2.

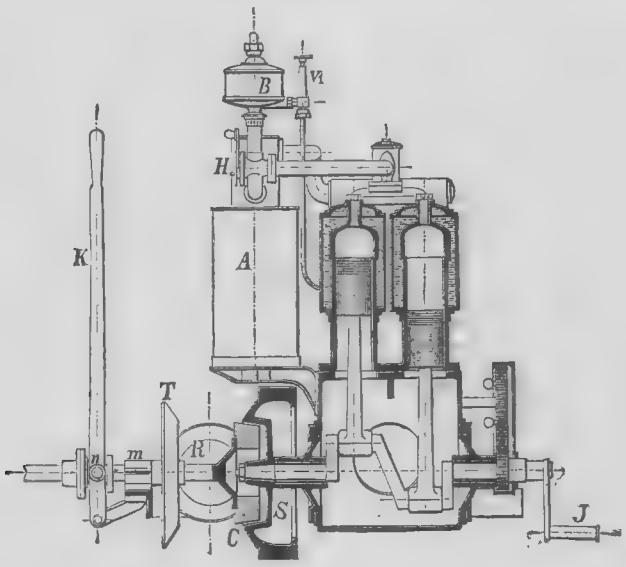

FIG. 3.

Coming now to the actual starting of the motor, this is done when it is out of gear. As soon as the percussion caps are red hot, the regulator valve H is opened slightly more than half-way. The crank handle J (Fig. 3) is then turned quickly once or twice to the right, when the motor, drawing in the explosive mixture, which is fired as already mentioned, starts; the crank handle is automatically put out of action as soon as the motor is properly running. The exhaust passes through tubes into the atmosphere. The regulating valve H is opened more or less until the right speed is obtained. The combustion chamber of the cylinder is surrounded by a water jacket, through which water is circulated by means of a force pump, to cool the cylinder; and in the case of the launch mentioned above, a pulsometer pump was used. The petrol used is of from 0·680 to 0·700 specific gravity. From Fig. 3 will easily be understood the working of the launch motor, K being the operating lever or reversing handle, and T, R, C, and S a set of cones for the forward and inverse working of the engine. Before the motor is turned by hand, the reversing handle is placed in the centre so that the shaft is out of gear; the moving of this handle forward or towards the motor puts the shaft in headway gear, whilst the arranging of the handle towards the stern puts it in sternway gear.

The launch tested is named the "Everywhere" (Fig. 5). The motor is, as already mentioned, of 4H.P. nominal of the two-cylinder type, and within two minutes after lighting the lamps—one being required for each cylinder,—she was running at full speed of seven miles an hour. The vessel containing the petrol was placed in the bow of the boat, and was pumped into the vaporising and lamp-supplier chambers. The launch ran exceedingly well, and no smell was emitted. This is an important point in oil launches, and the Daimler launch is safe from explosion, the petrol being used drop by drop as required.

A visit was subsequently paid by our representative to the works of Messrs. Watkins and Co., of Orchard Yard, Blackwall, London, E., where other launches on this system are being equipped. Of these, one is for the London County Council, and is to be ready in a month. She is being fitted with a 10H.P. motor, and is intended for the use of the Council at and about the sewage outfalls at Barking and Crossness. Another launch is being fitted out for a gentleman at Windsor. In concluding this brief notice of the Daimler motor, it may be mentioned that its applications are numerous. For instance, it is used for tramcars, as in Fig. 4, one being in operation at Krupp's works, at Essen, for the transport of Government officials and others down to the firing ranges; for fire engines, the propulsion of light and heavy road vehicles, and for stationary work, etc. As regards launches, they are made to carry up to as many as 100 passengers, and are specially used for river and harbour service, there being no less than 80 in operation in Hamburg alone.

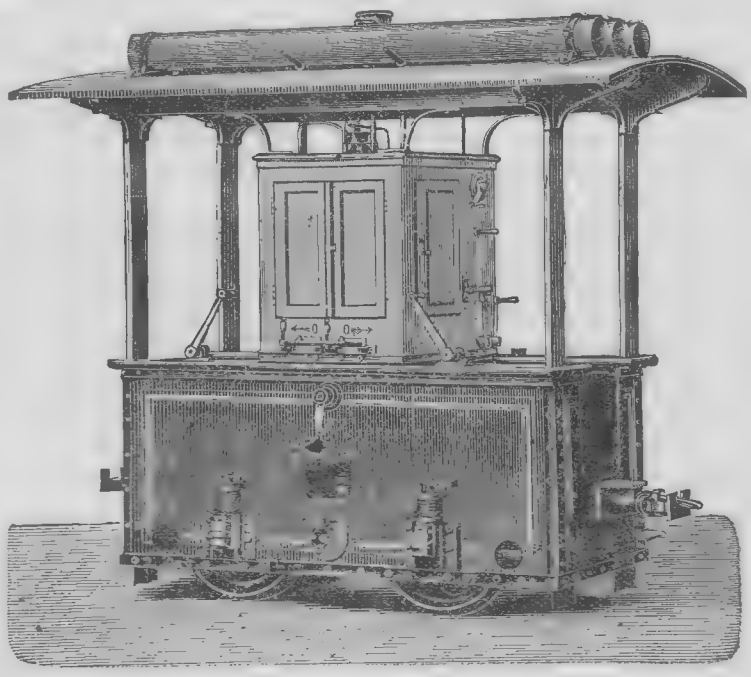

FIG. 4.

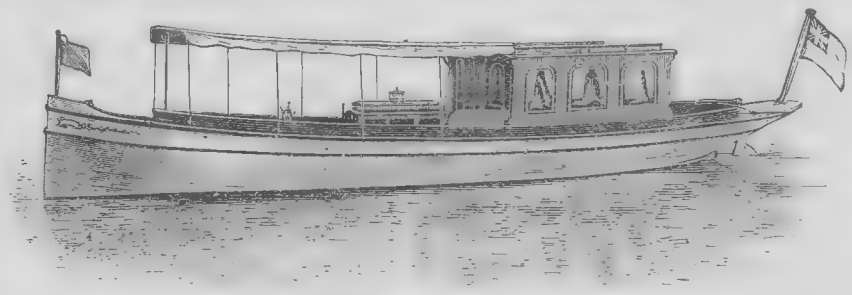

FIG. 5.

Birmingham Association of Mechanical Engineers.

THE opening meeting of the session of the above association was held on the 8th inst. at the Grand Hotel, Birmingham. The president, Mr. A. Driver, occupied the chair, and the vice-chair was taken by Mr. J. Floyd, vice-president. After the ordinary business had been transacted, the president made a feeling allusion to the death of Mr. H. Guy, of Handsworth, one

of the founders of the association. It was decided that Mr. T. Meacock, past president, and Mr. J. F. Crockatt, treasurer, represent the association at the funeral. The remainder of the evening was devoted to vocal and instrumental music.

Testing Copper Pipes.

NAVAL engineer officers at the New York Navy Yard have been testing copper pipes, to find the influence upon their strength by handling, and also to determine the effect of various thicknesses of metal and temperatures of brazing upon the strength of the seam and of the material adjacent thereto. They say that, to attain the best results, the metal should be the same throughout the pipe, and this can be attained by annealing or planishing after other work has been done, or, as is sometimes the practice, to avoid the danger of changing the form and length of the pipe after it has been made to a templet, it is planished to within a few inches of the end before the flanges are put on, and finished afterwards. Of the two processes, it is plain that planishing is preferable. The loss of ductility which results from the treatment is more than offset by the gain in the strength of the sheet, but it is at the joint that the principal advantage is gained.

While the difference in strength between the annealed and planished specimens without joints is from 4 to 5 per cent., in the case of specimens with joints it is from 9·5 to 11 per cent. On planishing a joint, however, unless the work is done properly it may lose rather than gain by the operation. The planishing should be commenced back of the lap and carried forward to the edge, for if it is commenced at the edge, the lap at this part having become stiffened, will separate from the brazing metal and curl up as the work progresses backward. The distension of the planished pipes was fairly uniform at different points until they had again been subjected to heat, and submitted to test without being re-planished.

A comparison of the results attained show nothing in favour of banded pipes; on the contrary, it appears possible that, under the conditions of test, the bands may have exerted a detrimental influence on the final strength of the pipe. Placed just at the edge of the soft metal at the ends, they probably accentuate the irregular strains which occur at this point, and cause the pipe to give way at a lower pressure than it would had they not been used. In any case, it is shown that the bands, when spaced, as they were, offer very little support to the intermediate metal if it is soft.

In regard to cone joints, it was found that owing to the greater resistances to compression of the metal in the brazed joint, the outside rings would not pull up squarely, and the joint would leak persistently at this point. Even if the metal in the pipes was of uniform compressibility it was not probable that the joint could be kept tight, for the greater expansion by heat of the composition ring compressed the copper between it and the outside iron rings, so that the joint was found to be always loose after having been subjected to heat.

A flange joint tried on one of the sections after the cone joint had been abandoned was tight up to 600lb. per square inch, when the springing of the joint by pressure on the heads was sufficient to allow it to leak. Sweated flanges appeared to be equally efficient with brazed flanges, and as soda melts at 500°, while the melting point of brazing metal is about twice as high, the pipe is exposed to less danger of overheating in putting them on.

The flanges in soft bronze were in every case dished by the endwise pressure from ⅛ to ¼in. Their strength seems to be well-adjusted to that of the pipe. Many kinds of material were used for gaskets in the joints, and one of the most satisfactory was made of annealed copper tubing of small diameter, with a core of soft cord, but it was found that the joint made of ¼in. asbestos board best stood the condition of test.—"Engineer" (N.Y.).

MM. OLIVET, of Geneva, have brought out a new system of electric heating applied to conservatories, which may prove very useful where a motor force is at one's disposal. A dynamo, worked by some motor, sends the current into receivers of special metallic composition, which become rapidly heated, but without exceeding a certain temperature. A heated air current is set up as with steam heating. The advantages of the system are:—Absence of all unwholesome gas or vapour which might injure the plants, simplicity of construction in the parts conveying the energy, perfect safety as regards heat, which can be regulated at will, convenience and rapidity in starting and extinction, and cleanliness.

German Feed-water Heaters and Surface Condensers.

IN all efficient feed-water heaters the question of keeping them thoroughly clean and free from heat-absorbing incrustations is a very serious one, and any important improvement that will lessen the cost of cleaning, and simplify their use, will be welcomed by the painstaking engineer.

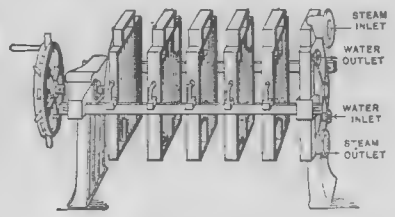

FIG. 1.

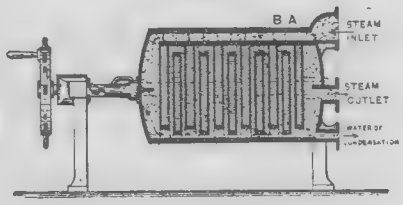

FIG. 2.

The simplicity and evident efficiency of Klein's compartment feed-water heater and surface condenser, recently introduced in Germany, will be evident from the following description.

This feed-water heater consists of hollow cast-iron plates or sections held in position by a supporting frame, as shown in Fig. 1. These sections are clamped tightly together by means of a strong screw as shown in the section Fig. 2, and the joints are made watertight by pasteboard packing. If these sections are clamped tight in the proper position they form a succession of channels with a very large surface. The steam circulates alternately up and down through the interior hollow space of the sections, and heats up the cast-iron sections. The feed water circulates through the channels formed by the hollow spaces of two adjoining sections, and is heated by the contact with a large heated surface, this surface being increased by numerous ridges, as shown in Fig. 3.

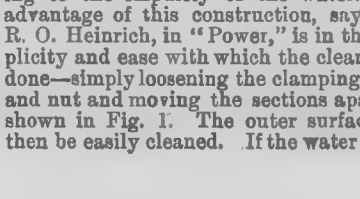

FIG. 3.

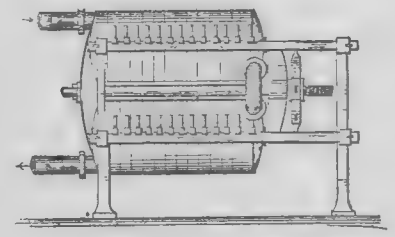

FIG. 4.

Almost all solid substances contained in the water are deposited on the outer surface of the sections, as in other heaters, and the crust thus accumulating has to be cleaned off more or less frequently according to the impurity of the water. The advantage of this construction, says Mr. R. O. Heinrich, in "Power," is in the simplicity and ease with which the cleaning is done—simply loosening the clamping screw and nut and moving the sections apart, as shown in Fig. 1. The outer surface can then be easily cleaned. If the water comes to the heater under low pressure (up to 30lb.), rectangular frame plates are used. If the heater, however, feeds directly into the boiler, with a pressure of from 45 to 105lb., the plates are circular and the packing is laid in a groove. Large heaters are most conveniently arranged one above the other, as shown in Fig. 4. The heating is, of course, generally done by exhaust steam. The following experiment was made at the Hoechster Farbenwerke, Hoechst-on-the-Main: The heater was 6ft. 8in. in length, and contained 12 sections of 40in. square, having a heating surface of 279 sq. ft. (counting in the surfaces of the ridges); using the exhaust steam of two engines, one being 22 by 25·6in., making 106 revolutions per minute, the other 12·8 by 25·6in., making 85 revolutions. Time of experiment, 60min.; temperature of water at inlet, 37·4° F.; temperature of water at outlet, 165·2° F.; quantity of water heated, 3500gals.; quantity of condensed water, 495gals.; temperature of condensed water, 194·4° F. The heat regained from the exhaust steam amounts in this case to 3,747,265 B.T.U. per hour; and the proportion of condensed water to cooling water was as 1 to 7.

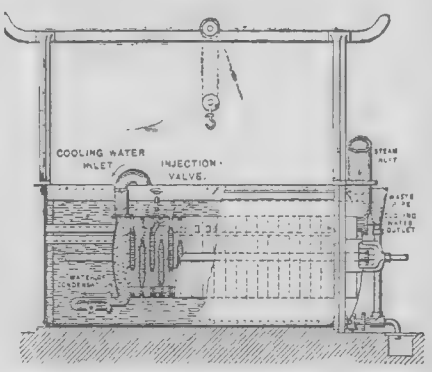

FIG. 6.

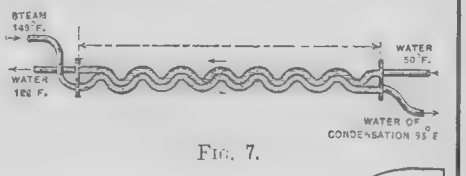

FIG. 7.

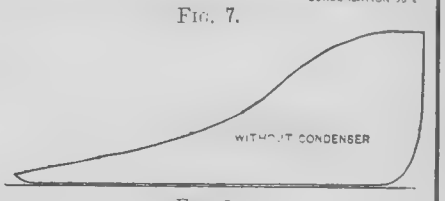

FIG. 8.

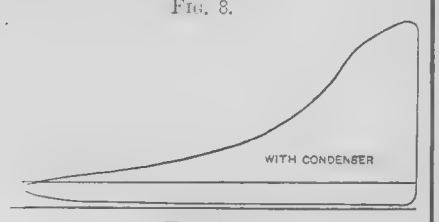

FIG. 9.

Instead of using exhaust steam, the steam can be taken from a boiler direct provided the pressure is brought down to 15lb. or 30lb. by a reduction valve for the rectangular heater. The circular heater can be fed with high-pressure steam, which is advisable if the feed water enters under high-pressure steam, so as to have nearly the same pressure on both sides of the compartments. The channels can be laid horizontally as well as vertically. If vertical channels are adopted without ridges on the outside of the plates, the cleaning can be performed very easily while the apparatus is in operation, with a special brush made for the purpose.

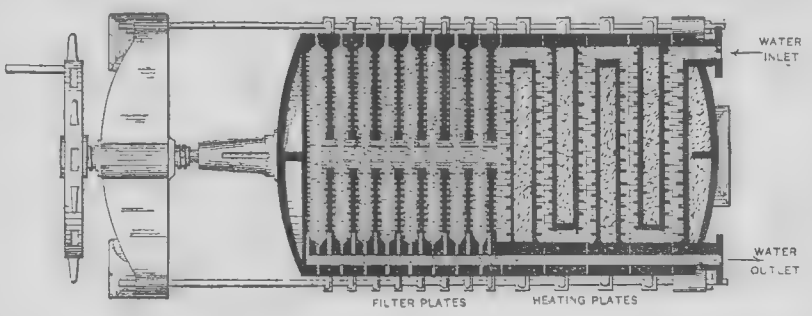

FIG. 5.

In combination with a filter press the heater is well adapted for the purifying of feed water (Fig. 5). The water is made alkaline by the addition of soda, and as soon as it is heated the lime and magnesia are precipitated and the water becomes turbid. This turbid water is then passed through a filter, and enters the boiler perfectly pure. For large steam plants the heater and filter are used separately, but for smaller plants both are used in combination, as shown in Fig. 5.

In a similar construction this compartment heater may be used as a surface condenser. If the exhaust steam is passed into such an apparatus and a sufficient supply of cooling water circulates through the outer compartments, the whole volume of the steam will be condensed. The water of condensation and the air contained in the steam are removed from the apparatus by an air pump. In order to make the apparatus air-tight it is entirely immersed in water (Fig. 6). Fig. 7 shows the action of the cooling water upon the steam according to the law of counter currents. In consequence of this law the temperature of the outflowing condensed water is comparatively high without injuring the attainable vacuum, and the quantity of condensing water is materially reduced.

Experiments show excellent results with this surface condenser. One was as follows:—Cooling surface, 169sq. ft.; vacuum, 26 to 26·4in.; temperature of outside cooling water, 131° F. (amount of water per hour, 40gals.); temperature of inside cooling water, 122° F. (amount of water per hour, 200gals.); injection water for air pump and condensed water, 122° F. (amount used per hour. 344gals.); temperature of condensed water leaving the condenser, 151° F. (amount per hour, 45·5gals.). This experiment shows that the whole amount of cooling water was only about 12 times the amount of condensed water.

The results of another experiment were as follow:—Cooling surface, 169sq. ft.; vacuum, 24·4in.; temperature of outside cooling water, 123° F. (amount per hour, 13·4gals.); temperature of inside cooling water, 117° F. (amount per hour, 174 2gals.); injection and condensed water, 106° F. (amount per hour, 344gals.); temperature of condensed water, 143 6° F. (amount per hour, 45·5gals.). The amount of cooling water was 10·7 times the amount of condensed water.

From these and similar experiments the following facts can be gathered:—The quantity of cooling water was less than one half that necessary for an injection condenser. In the same measure as the initial temperature of the cooling water rises, the quantity required increases; for instance, with a vacuum of 25in. and an initial temperature of 77° F., nine times as much cooling water was used as the condensed water amounted to.

Another marked feature of the apparatus is that the cooling water does not have to pass through any valves, and does not come into contact with the steam and condensed water, and therefore need not be pure and free from solid substances. The following test of a 7H P. engine, with and without the surface condenser, illustrates the efficiency of the apparatus very strikingly. The engine had the following measurements:—Cylinder, 10in.; stroke, 20in.; revolutions, 80; steam pressure, 75lb. The diagrams (Figs. 8 and 9) are taken without and with the condenser, and the average results were as follow:—Steam used without condenser, 25·8lb. per horse-power per hour; steam used with condenser, 18lb. per horse-power per hour; saving, 7·8lb—a saving of 30 per cent.

How to Temper a Spring.

TEMPERING a spring is not the hard job which some smiths, professional as well as amateur, seem to make of it. In getting ready to temper a spring, one should begin with the forging itself, for if that be not well done, no amount of "know how" can make a success of the tempering. The forging should be done with low heats and light blows, and the steel should not be hammered while cold, with heavy blows at least. Avoid making hammer marks in the steel when forging, for although such marks may be worked out, they do not add to the strength or long life of the spring. A good many failures of seemingly perfect springs could doubtless be traced to this little point in the forging. After the spring has been hammered to size, spend a little extra time in lightly hammering the steel when it is nearly cold—but don't strike hard. The light hammering will toughen the steel, and make a better spring. The outside surface or "skin" seems better adapted to spring work, where the surface is hammered up instead of being filed or ground. After hammering, polish the spring with a bit of emery paper. It is best not to put

it on an emery wheel, for then the skin above described would be destroyed. Sometimes, however, it is necessary to partly shape the spring by grinding, but let this be done at an early stage of the job, so that the outside skin may be restored as much as possible. When ready for the hardening, there are two ways of doing the heating—either by holding the spring over a clean fire with a small pair of tongs, keeping the spring high up, so that it will heat slowly, or by first heating a heavy piece of iron red hot, and then placing the spring on that until the steel is heated. A modification of the latter method is to heat some lead red hot in a ladle and plunge the spring in that; but when this is done, the spring should first be heated in the fire until it is at least black hot, that the sudden shock of meeting the red-hot lead may not cause disastrous strains in the steel. When the spring is fully and uniformly heated to a light red, plunge into cool, but not ice-cold, water. The amount of twist that is got into the spring by this operation depends on the manner in which the spring is put into the water. If it be put in so that a flat side touches first, the sudden cooling of that side will cause the spring to be pulled out of shape, and held there by the subsequent cooling of the rest of the spring. If put into the water endwise, or straight, there will be but little distortion of the spring. After hardening, polish the steel with a bit of emery cloth until the metal is bright, clean and white. Then put a few drops of oil on a bit of paper, light it, and hold under the spring until every portion of its surface is covered with a thick coating of smoke. Next heat the spring slowly, holding it high up over the forge fire, until the smoke is all burned off; but it should all go alike. Don't let one part of the spring get so hot that the smoke is all burned off, while another part is thickly coated. That means a spring of uneven temper, that will break in short order. When the smoke has been carefully burned off, lay the spring on the ashes of the forge to cool slowly, and in a few minutes it will be ready for work.—"The Tradesman."

Institution of Mechanical Engineers.

THE ensuing ordinary general meeting of this institution will be held on Wednesday evening, 26th, and Thursday evening, 27th October, at 25, Great George-street, Westminster, by kind permission of the Council of the Institution of Civil Engineers. The chair will be taken at half-past seven p.m. on each evening by the president, Dr. William Anderson, F.R.S. The following papers will be read:—"Second Report of the Research Committee on the Value of the Steam Jacket," Mr. Henry Davey, chairman. Records of experiments made by members of the committee:—On a compound beam pumping engine at Hammersmith; on a triple-expansion pumping engine at Waltham Abbey; on a compound horizontal saw-mill engine at Woolwich; on an experimental engine at South Kensington; on a sing'e-cylinder vertical experimental engine at Bermondsey; suggestions for future experiments; index and summary of experiments on the value of the steam jacket. "Experiments on the Arrangements of the Surface of a Screw-propeller," by Mr. William George Walker. Seven propellers differing only in arrangement of virtual surface, with two and four blades, and with three and six; description of yacht; mode of experiment; measure of efficiency; examination of results; sum of pressures of slip and propulsion; discussion of results; practical trials on sea-going steamers; comparison of six-bladed and ordinary four-bladed propellers; trial on tug steamer; tabulated results of experiments with the seven propellers, and of trials in voyages.

The Cost of Power Transmitted by Electricity.

THE author remarks that the transmission of power to a distance had been rendered possible by the use of high potentials, and by the improvements which had been made in electro-motors. The latter machines have now an efficiency of 90 to 92 per cent., and are therefore superior to all other power machines. He considers the question of the possibility of the economical transmission of power over great distances a most important one for a State. The Lauffen-Frankfort transmission had proved economical; but the circumstances were extreme, and much better results would be obtained where power was transmitted over smaller distances.

Central stations would not be put down to feed areas of 215 miles diameter; but if areas of 72 miles diameter were taken the results would be much more satisfactory. It was quite possible to use pressures of 15,000 and even 30,000 volts. In the author's opinion, the same satisfactory results could be obtained with large steam plants as were obtained at Frankfort by the use of the cheap water-power at Lauffen. The great difference in the cost of 1H.P., produced on the one hand by a small steam engine and on the other by a large steam-engine at a central power station, had not yet been realised. The author then gives Table I to show the relative costs.

TABLE I.—COST IN PENCE OF 1H.P.-HOUR PRODUCED BY A STEAM ENGINE WITH COAL AT 14s. PER TON.

—	Private Plant without Condensation.						Central Station with Condensation.				
Horse-power	2·5	5	10	25	50	100	500	1000	2000	5000	10,000
Number of hours worked per annum..... (1000	3·95	3·04	2·55	1·61	1.22	1·00	0·82	0·70	0·65	0·57	0·50
(3000	2·45	1·94	1·54	1·03	0·79	0·69	0·50	0·46	0·43	0·38	0·32

The figures given in the above table were obtained by Prof. Salomon, chief engineer to Messrs. Lahmeyer and Co., from experiments which he had previously made when at the Royal Technical School, Aix-la-Chapelle. The depreciation allowed in the table was obtained from an analysis of the figures current in Rhineland and Westphalia, and with a different rate the figures would of course vary. It appears, therefore, that with 1000 working hours per year the H.P.-hour costs, in a private installation, where a 2½H.P. engine is used, 3·95d. The figures show clearly the great advantage of obtaining power from a central station if the cost of distribution is not excessive. The engines at the central station will work, also, a much greater average of hours than those in private installations, as they will supply only the power actually required at any moment.

The author then considers a central station of 10,000H.P. capacity, feeding an area of 62 miles diameter. The cost of such a central station, worked upon the Drehstrom system, and three wires, would be about as follows:—

Buildings and steam engines	100,000
Cables	45,000
Other electrical plant	100,000
£245,000	with extras, say, £250,000.

The total length of the transmission is supposed to be 186 miles, or a total of 558 miles for the three mains.

The following Table II. gives the cost of power obtained from such a station. The cost is given in pence at the consumer's terminals.

TABLE II.

Number of Hours worked per Annum.	Coal at 14s. per Ton.		Coal at Pit's Mouth 5s. per Ton.	
	Per Kilowatt Hour.	Per H.P. with Large Motors.	Per Kilowatt Hour.	Per H.P. with Large Motors.
1000	1·68	1·42	1·50	1·26
3000	0·93	0·78	0·75	0·635
5000	0·74	0·63	0·57	0·48

The author remarks that although it might be difficult to arrange the supply of current to such a large area, yet a larger amount might be required for a smaller area. The correctness of the figures merely depends upon the possibility of using overhead wires, and these might be run along the railways instead of the streets. The author then gives a table of the cost of overhead and underground cables for a potential of 20,000 volts, with 15 per cent. maximum loss in transmission. The table refers to powers varying from 100H.P. to 10,000H.P., and it appears that the cost of underground cables is at least ten times that of the overhead lines. The author then discusses the objections which have been raised by the postal authorities in Germany to the use of overhead lines of high potential in the vicinity of telephone and telegraph wires. He considers that it would be preferable for the Government to be obliged to use metal returns for their wires, and to cross the wires, rather than put the distribution companies to ten times the expense for their mains. The rest of the paper is a discussion of the question of the best method of avoiding induction effects in neighbouring wires, and is largely of a political nature.

* Inst. C.E.: Foreign Abstracts.

The Chemical Examination of Boiler Feed Water.—II.

[CONTRIBUTED.]

Solid Matter in Solution. — Carefully clean a porcelain or platinum (the latter is preferable) evaporating dish of about 100cc. capacity, dry in the water oven, allow to cool in the desiccator, and accurately determine the weight. Place the dish on the water bath, and measure out from a pipette into it 70cc. of the filtered or unfiltered water, as the case may be, and evaporate to dryness. A very simple bath may be made by placing the dish on the top of a beaker partially filled with water, inserting pieces of paper between the sides of the dish and beaker should the former fit air-tight. When this is effected, remove the dish to the water oven, dry for an hour, transfer to the desiccator, allow to cool, and weigh without loss of time. Replace the dish in the water oven, dry for another hour or so, cool, and weigh as before. If the second weighing does not agree within the limit of experimental error, repeat the drying until a constant weight is obtained. The increase in weight of the dish equals the total solid matter in solution in 70cc. of the water, which, multiplied by 1000, gives the amount in grains per gallon.

Having thus determined the total solid matter, place the dish over an Argand burner, and ignite at a very low temperature until the residue is white, unless coloured by iron. Remove the dish to the desiccator, allow to cool, and weigh. The weight thus found gives the solid mineral matter in solution in 70cc. of the water, which deducted from the total solid matter in solution gives approximately the organic matter in solution. Calculate into grains per gallon by multiplying by 1000.

Estimation of Chlorides.—Chlorine is generally present as chloride of sodium (common salt), and sometimes as chloride of potassium, chloride of calcium, and chloride of magnesium.

For the determination of the chlorine a volumetric method is mostly used, and the following reagents are required:—

Solution of Chromate of Potash.—Dissolve 97·25grms. of potassium chromate in a litre of water.

Standard Solution of Silver Nitrate.—Dissolve 4·79grms. of pure crystallised silver nitrate in water, and make up the solution to a litre. Each cc. of this solution is equivalent to 0·001grm. of chlorine (Cl).

Method. — In two No. 3 beakers place respectively 70cc. of distilled water and of the water under analysis. Commencing with the distilled water, add to it 2cc. of the potassium chromate solution, and stir. Now run into it from a burette of 50cc. capacity, graduated in one-tenths, at the rate of a drop at a time, the standard solution of silver nitrate, constantly stirring with a glass rod until the water takes a decided permanent red colour. This being effected, note the number of cc. required to produce the colouration. It will be noted that upon the silver nitrate coming in contact with the water a red precipitate is formed, which upon stirring, and whilst in small quantities, dissolves, at the same time producing the change in colour. Now, operating upon the water under examination, add to it 2cc. of the potassium chromate solution, as in the first case, and run in, with constant stirring, from the burette filled to the zero mark, the standard solution of silver nitrate until a permanent red colour is obtained, exactly equal in tint to that of the distilled water. From the number of cc. requisite to bring about this colouration deduct the number of cc. required to produce the standard colouration, and the remainder will equal the grains of chlorine per gallon. In operating upon the water under analysis, it will be observed that the red colouration is not, as was the case with the distilled water, immediately produced, but a white precipitate—chloride of silver. It is only when the whole of the chlorine is precipitated that the red colouration is produced.

With highly-coloured waters, the final point of the reaction is frequently not distinctly visible. When such is the case, add to the water a small quantity of lime water (free from chlorides), and conduct a current of carbonic-acid gas through. Heat the solution to boiling, filter, cool the filtrate, and determine the chlorine as above.

Sulphates.—Measure out into a suitable vessel, either an evaporating dish or a beaker, 1000cc. of the clear water; acidulate with pure hydrochloric acid, and reduce by evaporation to a volume measuring about 250cc. Filter the remaining solution if necessary, and to the filtrate, or solution, as the case may be, add 10cc. of a solution of barium chloride (prepared by dissolving 120grms. of the crystals in a litre of water). Bring the solution to boiling, and allow to stand for at least twelve hours, the mouth of the containing vessel being closed to exclude dust. Subsequently collect the resulting precipitate of barium sulphate ($BaSO_4$) on a double ashless filter paper. The solution should be filtered hot, otherwise difficulty will be experienced in obtaining a clear filtrate. Wash thoroughly with hot water, dry the filter paper, ignite in a tared crucible, and then determine the weight of the barium sulphate ($BaSO_4$), which, multiplied by 0·34,335 and 70, will give the grains of sulphates (SO_3) per gallon.

The Analysis of the Solid Residue.—Measure out 1000cc. of the water, acidulate with hydrochloric acid, and fill a small porcelain or platinum dish to within half-an-inch of its edge with the water, and place on the water bath. As the liquid evaporates, add successive portions of the water, until the whole of it has been transferred to the dish. Rinse out the containing vessel with distilled water, and add the rinsings to the contents of the dish. Now evaporate the water to complete dryness, and heat the dish and contents at a temperature of about 130° C. for an hour, to render the silica insoluble. Allow the dish and contents to cool, moisten with 10cc. of hydrochloric acid and 50cc. of distilled water, and digest (the mouth of the dish being kept covered with a watch glass) at a gentle heat until all the soluble matter is in solution. Rinse the watch glass with hot water in the dish, and collect the insoluble residue of silica (SiO_2) on a small filter, allowing the filtrate to run in a small lipped beaker. Wash the filter and contents with hot water, dry, ignite in a tared crucible, and weigh the silica (SiO_2), and calculate into grains per gallon by multiplying by 70. The volumes of the several filtrates should be kept as small as possible.

After washing the precipitates some five to six times, do not collect the washings.

Make the filtrate remaining from the separation of the silica as above slightly alkaline with ammonia, and heat to boiling until the solution smells very faintly of ammonia. Allow the precipitates of the oxide of iron and alumina thus obtained to settle to the bottom of the containing vessel, when filter through a small ashless filter paper, wash with hot distilled water, dry, and ignite in a tared porcelain crucible. Finally, weigh the oxide of iron and alumina (Fe_2O_3, Al_2O_3), and calculate into grains per gallon by multiplying by 70. The oxide of iron and alumina usually present is so small that they are estimated and returned together, and not separately.

To determine the lime (CaO) in the filtrate from the above estimation, proceed as follows:—Make strongly alkaline with ammonia, add about 5cc. of a solution of ammonium chloride (prepared by dissolving 250grms. of the crystals in a litre of water) and 10cc. of a solution of ammonium oxalate (prepared by dissolving 42grms. in a litre of water). Bring the solution to boiling, and allow to rest until the precipitate of calcium oxalate has subsided, after which filter through a small ashless filter paper, well wash with hot water, and dry. Ignite the filter paper and contents in a tared crucible, at a strong red heat, weigh the resulting lime (CaO), and calculate into grains per gallon by multiplying by 70.

Reduce by evaporation the filtrate remaining from the estimation of the lime to a volume measuring about 150cc.; add to it ammonia until strongly alkaline, and from 5 to 10cc. of ammonium phosphate solution (prepared by dissolving 50grms. in a litre of water); stir well, and allow to stand in the cold for at least 12 hours. Collect the resulting precipitate of ammonium magnesium phosphate on a small filter paper, employing a dilute solution of ammonia (1 part ammonia to 10 of water), to throw the precipitate on to the filter paper, and wash with the ammonia water. Dry the filter paper and contents, remove the dry precipitate as completely as possible from the filter paper to a tared crucible, incinerate the filter paper, allowing the ash to drop into the crucible, and ignite the whole very gently at first, and subsequently at a strong red heat. Finally, allow the crucible and contents to cool, and

reweigh to determine the resulting pyrophosphate of magnesia ($Mg_2P_2O_7$). From the weight of $Mg_2P_4O_7$ thus obtained, calculate the magnesia (MgO) in grains per gallon by multiplying by 0·36036 and 70.

The ammonio-phosphate precipitate being somewhat soluble, the volume of the filtrate and washings is measured, and for every 50cc. of the filtrate, etc., add 0·001grm. to the weight of the $Mg_2P_2O_7$ found.

(To be continued.)

Metal Trade Memoranda.

During the month of September, Italy exported 30 tons of copper ore to Great Britain.

The Willingsworth Iron Company, Wednesbury, are preparing another furnace for work.

30,535 tons of tinplates were exported from the United Kingdom during the month of September.

The Osaka Smelting Works, Japan, have been established to carry on the work of assaying and refining of gold, silver, and copper.

The Buderusschen Ironworks, near Lollar, Germany, have blown in an additional blast furnace. This will make six furnaces now in operation.

The Temescal Tin Mine at Cajalco Hill, San Bernardino County, which was worked by an English company, has been closed. This was the only tin-producing mine in the United States.

There were at the end of September 378 blast furnaces in operation in the United Kingdom, and at the same time there were about 381 that were out of blast, so that more than half of the smelting plant of the United Kingdom is unproductive.

The Dolcoath Tin Mine, Cornwall, has been in operation as a tin mine for fifty years. Up to 1890, the total production had been approximately 170,000 tons of block tin, valued at £9,000,000. The workings are now 2742ft. deep, and the production, instead of falling off, was 600 tons of tin for twelve weeks up to the end of August, greater than any return for a similar period of time in the history of the mine.

Official Gazette.

Partnerships Dissolved.

W. R. WYNNE and A. S. BARNARD, under the style of Wynne and Barnard, Newcastle-on-Tyne, electrical engineers.

J. LAWES and G. BIERBACH, under the style of James Lawes and Co., Birmingham, wire netting manufacturers and galvanisers.

J. and W. PUGSLEY and H. C. BISHOP, under the style of Henry Charles Bishop and Co., Bristol, boiler makers, engineers, and general smiths.

Trade Marks.

The following is the Official List of Applications published from October 5 to October 12, for the Registration of Trade Marks, so far as relates to the Metal Trades.

CLASS 5.

"The essential particular of the Trade Mark is the device, and we disclaim any right to the exclusive use of the added matter."

166,338—2821 S. Steel. THOMAS FIRTH AND SONS LIMITED, Norfolk Works, Sheffield; manufacturers and merchants.—6th August, 1892. *By consent.*

CLASS 35.

"The essential particular of the Trade Mark is the device, and the applicant disclaims any right to the exclusive use of the added matter."

165,666. Hair machine belting and similar goods in Class 35. JAMES EMMOTT SUTCLIFFE, trading as SUTCLIFFE AND SUTCLIFFE, 37, Upper Brook-street, Manchester; manufacturer.—29th June, 1892.

The Metal Market.

PRICES CURRENT.

LONDON, October 17.

COPPER opened strong, with early business at 7s. 6d. advance, three months realising £46 10s., and cash £46. The rise was well maintained for a time, but eased off slightly on less eagerness to buy, cash being done at £45 18s. 9d., and three months at £46 7s. 6d. Values rallied later on prominent support, three months to £46 12s. 6d., and an early promot to £46 2s. 6d., but the market closed at the initial prices, three months passing on the kerb at £46 11s. 3d. to £46 10s. There was a good general demand, buying being mainly influenced by American cables reporting the decision to close the Anaconda mine for three months from November 10. Sales, 1800 tons. Settlement price, £46. Messrs. H. R. Merton and Co. report the Chili charters for the first half of the month at 350 tons, against 1100 tons for the first half of September. Messrs. James and Shakespeare give the receipts (England and France) over the same period at 3280 tons, and deliveries 4252 tons, making a reduction of 972 tons in stocks, and making the total visible supply 56,710 tons, against 58,482 a fortnight since, and 60,663 a year ago. The receipts for the first half of September were 4272, and the deliveries 4089 tons. English tough, £49 5s.; best selected, £50s. 10s.; strong sheets, £58.

TIN met with a good demand at the opening, owing to the further rise in silver on Saturday, and £95 2s. 6d. to £95 5s. was quickly paid for cash. December 5 and three months making respectively £95 15s. and £96. Later on, owing to buying for consumers, cash again advanced to £95 7s. 6d., and £95 10s. was paid for 14 days. Warrants were kept off the market in the afternoon, and the close was firm at a gain of 10s. Sales, 60 to 70 tons. Settlement price, £95 7s. 6d. The official return of Straits shipments for the last 14 days gives a total of 1230 tons, of which 650 tons are for London and 580 for the Continent. The deliveries from London warehouse over the same period are about 460 tons, and warehouse stocks are now 2279 tons. English ingots, £98 to £98 10s.

PIG IRON has had a steady market; but buyers were indisposed to pay the prices asked, and the close was without change, buyers offering about ½d. under the quotations. Settlement price, 41s. 6d.

TINPLATES dull. I.C. cokes, f.o.b., London, 12s. 9d.; Liverpool, 12s. 3d.; Swansea, 11s. 9d.

LEAD remains quiet, and Spanish is £10 7s. 6d. buyers, £10 8s. 9d. sellers; English, £10 12s. 6d.

SPELTER is firmer with buyers for October shipment at £18 17s. 6d, and sellers at 2s. 6d. more.

ZINC SHEETS.—Silesian steady; ordinary brands, ex ship, £21 17s. 6d. Belgian quiet; V.M. brands, ex ship, £22; f.o.b., Antwerp, £21 17s. 6d.

OFFICIAL CLOSING QUOTATIONS.

	£	s.	d.	£	s.	d.
COPPER—						
G. M. B.—Cash	46	1	3	46	8	9
" Three months	46	12	6	47	0	0
English tough	—			—		
Best selected	—			—		
Strong sheets	—			—		
TIN—						
Fine foreign—Cash	95	7	6	95	17	6
" " Three months	96	0	0	96	10	0
Australian—Cash	95	17	6	96	7	6
PIG IRON—				s.		d.
Scotch warrants—Cash				41		6
" One month				41		8
Middlesbrough—Cash				Nom.		
" One month				—		
Hematite—Cash				Nom.		
" One month				—		

GLASGOW, October 17.—The pig iron market was very quiet in tone to-day. Scotch only was dealt in, and some 8000 tons changed hands. At first the price was flat, 41s. 5d. cash was no more than commanded, and ½d. less was the price for a time, but just at the finish of the market there was a sharp recovery to 41s. 6d., where sellers remained over. Cleveland and hematite were unchanged. Last week there were 5332 tons of Scotch iron shipped, being 84 tons less than on the corresponding week last year, thus reducing the increase to date to 21,312.

QUOTATIONS.

	Highest.		Lowest.	
	s.	d.	s.	d.
Scotch warrants—Cash	41	6	41	4½
" One month	41	7½	41	6½
Middlesbrough—Cash	38	6	38	6
" One month	—		—	
Hematite—Cash	48	6	48	6
" One month	—		—	

New Companies.

STANDARD SEWAGE AND WATER PURIFICATION COMPANY LIMITED.—This company was registered on the 3rd inst., with a capital of £40,0, in £1 shares, to carry on business as chemical manufacturers and purifiers of sewage in all its branches. Registered, without special articles, by Drake, Driver and Lever Limited, 13, New Bridge-street, E.C.

SCHIELE UNION ENGINEERING COMPANY LIMITED.—This company was registered on the 8th inst., with a capital of £12,000, in £1 shares, to carry into effect an agreement expressed to be made between the Union Engineering Company Limited and Mr. E. Crewdson, its liquidator, of the one part, and this company, of the other part, for the acquisition of the undertaking of general engineers hitherto carried on by the said Union Engineering Company Limited, and to carry on and extend the same in all its branches.

JAMES SIMPSON AND SONS LIMITED.—This company was registered on the 8th inst., with a capital of £25,000, in £10 shares, to acquire and take over as a going concern, upon such terms as shall be thought fit, the partnership business of bolt and nut manufacturers now carried on at Darlaston, under the style or firm of "James Simpson and Sons"; to carry on in particular the business of bolt and nut manufacturers, and generally to carry on the trades or businesses of tool manufacturers, ironmasters, iron and steel manufacturers, etc.

F. REDDAWAY AND COMPANY LIMITED.—This company was registered on the 11th inst., with a capital of £250,000 in £10 shares, to enter into and carry into effect, either with or without modification, an agreement expressed to be made between Mr. Frank Reddaway, of the one part, and the company, of the other part, and which agreement is for the acquisition by the company of the business now carried on under the style of "F. Reddaway and Co." at Cheltenham-street, Pendleton, and at Hamburg, Moscow, Paris, and elsewhere; also to enter into and carry into effect, either with or without modification, an agreement expressed to be made between Messrs. R. Kerr, T. Jubb, W. S. Kerr, J. R. Kerr, and W. Kerr, of the one part, and the company, of the other part, for the acquisition by the company of the business carried on under the style of "Kerr and Jubb," at Halifax. Managing director, Mr. F. Reddaway. Registered office, Cheltenham-street, Pendleton, Lancashire.

MAWDACH COPPER COMPANY LIMITED.—This company was registered on the 6th inst., with a capital of £10,000, in £1 shares, to carry on the general business of a mining company by purchasing, leasing, acquiring, and working mines, ore, minerals, and exercising the mining and other rights acquired by the company, to carry on the general business of smelters and reducers of ores and minerals obtained from the properties of the company, or any other ores or minerals, and to purchase, treat, smelt, reduce, and convert into metal ores or minerals of any kinds.

OMNIBUS AND WAGON STARTER SYNDICATE LIMITED.—This syndicate was registered on the 10th inst., with a capital of £5000, in £1 shares, to carry on all businesses in connection with the manufacture, sale, letting by licence or otherwise, in such manner as the directors of the company may from time to time determine, of all articles, machines, and effects, and more particularly of the omnibus and wagon starter, and to adopt and carry into effect, with or without modification, an agreement dated September 12, 1892, and made between Messrs. C. J. Beeton, as vendor, of the one part, and C. Harris (for the syndicate), of the other part.

GENEVA SCREW AND RIVET COMPANY LIMITED.—This company was registered on the 4th inst., with a capital of £3000, in £1 shares, to adopt and carry into effect an agreement expressed, to be made between Messrs. D. Barnett, J. A. Cooke, and J. Taylor, of the one part, and this company, of the other part, for the acquisition of the undertaking of screw, rivet, and bolt manufacturers, hitherto carried on under the style of "Barnett and Cooke," at Colley-street, West Bromwich, Staffordshire, and to carry on and extend the said business in all its branches; also as electro-platers, electricians, and mechanical engineers, etc. Registered by Messrs. Jordan and Sons, 120, Chancery-lane, W.C.

YOUNG'S REVERSIBLE NUT-LOCK SYNDICATE LIMITED.—This company was registered on the 6th inst., with a capital of £12,500, in £5 shares, to acquire by grant, purchase, licence or otherwise, any inventions, patents, patent rights, brevets d'invention, copyrights, licences, concessions, or other similar rights, or any secret or other information as to any invention or process which may seem capable of being used for any of the purposes of the company, etc.; to enter into and carry out, with such modifications, if any, as may be agreed on, an agreement (the terms of which do not transpire) having for its object the purchase and acquisition of a certain invention for improvements in locking nuts on bolts used in fastening the fishplates on the rails of railroads, and for like purposes, and the patent or patents for the same granted to Messrs. Levi, Hildreth and Young, for the United Kingdom of Great Britain and Ireland and Isle of Man, and the exclusive right to take out and acquire patents or other similar rights in respect of the said invention in Germany, Russia, Denmark, Norway, Sweden, etc.; to carry on the business of iron-masters, boiler-makers, steel-makers and founders, mechanical and other engineers, and public works contractors in all their respective branches.

Letters to the Editor.

*** *We do not hold ourselves responsible for opinions expressed by correspondents.*

*** *The name and address of the writer (not necessarily for publication) must in all cases accompany letters intended for insertion, or containing queries.*

*** *Letters intended for publication in the current week's issue must reach our Manchester Office not later than by the first post on the Tuesday preceding the date of publication.*

CONSTRUCTION AND EFFICIENCY OF LOCOMOTIVE BOILERS.

To the Editor of THE MECHANICAL WORLD.

SIR,—It is gratifying to know that my humble linguistic efforts meet with the approval of your correspondent, even though they fail to carry conviction. Whilst quite in accord with his opinions as to the aid which a study of the dead languages is likely to lend to the art of boiler-making, I by no means wish to imply lack of appreciation of its influence on the development of other arts.

Experience and theory tend equally to attach greater importance to an extended water-plane and high steam pipe, than to the frequently concomitant, but not indispensable, greater cubic capacity.

Makers and users alike will view with distrust cast-steel roof bars with such a multiplicity of cores; and plant for forging the girders with bolt holes as suggested would be interesting, but hardly suitable as an investment for those who have to work harder for their income than do English railways. Built-up roof bars are not desirable, on account of the invisible rivets or other fastenings, which may prove unreliable and give no warning of failure.

The point of your correspondent's argument as to the strain on sling stays is somewhat blunted by the consideration that in order to substantiate his position it is necessary to assume a tangible remainder after subtracting the sum of height of firebox plus length of sling stays and attachment from the vertical height of the firebox shell.

Apart from the question of bad material, the cause of broken stays—and of most other matters affecting the working expenses—will be found to lie within the drawing office; an expenditure of a few hundreds per annum in salaries is often a better investment than the sinking of thousands in the purchase of special machinery which slight changes in design or fashion may render obsolete.

Birmingham, Oct. 11. J. D. T.

THE GULLIBILITY OF INVENTORS.

To the Editor of THE MECHANICAL WORLD.

SIR,—I was much pleased to see your leading article in a recent issue. Your remarks are true, and ought to show people the real facts of the case. I may say I received the same kind of letter on or about the 23rd December, 1891. I felt flattered, of course, to have my very small invention noticed by our French neighbours, and had some thoughts of corresponding with them; but on consideration I did not. I received one letter about ten months after obtaining my first patent at home, and the second two months after making an application for a second patent. Of course it was impossible for them to know the value of my last invention, seeing I had only filed my provisional specification. JOHN R. MILLER.

Wakefield, Oct. 10.

Miscellaneous Items.

A chemical preparation of camphor is said to be one of the principal ingredients forming smokeless gunpowder.

Sir Henry Roscoe, M.P., F.R.S., has recently been elected an honorary member of the Society of Engineers in the place of Professor John Couch Adams, F.R.S., deceased.

The Niagara tunnel, which has cost £1,000,000, and by means of which the water power of Niagara will be used for manufacturing purposes, has been completed by the contractors.

The largest plate ever rolled in the United States was recently turned out by the Lukens Iron and Steel Company, of Coatesville, Pennsylvania. It is 400in. long, 113in. wide, and ½in. thick.

Captain Andrews, who crossed the Atlantic alone in the small boat "Sapolio," announces his intention of again crossing from the United States to Spain, this time in a boat constructed of aluminium.

Mr. Charles Mitchell, managing director of Sir William Armstrong and Co., Elswick Works, Newcastle, has intimated his desire to erect a block of buildings in the rear of Marischal College, to contain a graduated hall and students' union.

Mr. Yerkes, a prominent citizen of Chicago, has ordered for Chicago University a telescope which will be the largest and most powerful in the world. Mr. Alvin Clark, the famous optical instrument maker, has undertaken to cast the glass, which will be 45in. in diameter.

According to the results of tests recently communicated to the Engineers' Club, of Philadelphia, the operation of punching injures steel plates less than iron up to ⅜in. in thickness. Beyond this limit of thickness the injury to steel increases very rapidly, while the injury to iron continues constant.

Mr. Robert Thompson, the new president of the North-East Coast Engineers and Shipbuilders, states that the natural life of a ship is to some extent a question of where the ship is built. Vessels constructed in the United States last on an average 18 years, French ships average 20, Dutch 22, German 25, British 26, Italian 27, and Norwegian 30.

In the "Chemical News" Mr. Warren suggests an ingenious method of determining the quantity of steam produced in a boiler by a given weight of coal. Most waters contain chlorates, the estimation of which is easily effected by volumetric analyses. The only instrument required is a burette. The reagent is a standard solution of nitrate of silver, which is added to a known volume of water. The least excess of the silver solution is indicated by the red coloration which argentic nitrate gives with potassium chromate. By comparing the analysis of the water in the boiler before and after the trial, the quantity of steam produced can be calculated.

Queries.

☞ Readers are invited to avail themselves of this section for practical information on questions relating to Mechanical Engineering and the Scientific Industries.

☞ Queries and Replies should arrive at the Manchester Office not later than by the first post on the Tuesday preceding the date of publication.

PLUMBERS' UNION.—Required the address of the secretary of the Operative Plumbers' Union.—PLUMBER.

HORSESHOE NAIL MAKING MACHINERY.—Required the addresses of firms who are makers of this class of machinery.

COATING FOR WATER PIPES.—Can any reader tell me how to ascertain whether cast-iron pipes have been properly coated with Dr. Smith's solution?—WATER PIPE.

HARDENING AND TEMPERING.—Can any reader inform me how to harden and temper a number of straight steel wires 13 gauge and 16in. long? I have tried several ways, but I cannot keep them straight. I may say that I have hardened them in oil, and one at a time.—BLACKSMITH.

MOULDING SAND.—Will any reader inform me where the fine moulding sand is obtained which is used for making small malleable-iron castings in Walsall?—IRON FOUNDER.

SPEED OF LOCOMOTIVES.—Provided a railway line is laid as perfect as possible, can any engine attain such a velocity as to cause it to leave the rails owing to excessive speed only?—P. T. G.

SPEED OF FAN.—Can any reader give me a rule for calculating the speed a fan should run at to discharge a given quantity of air against a pressure of 2in. or 3in. of water. I mean in regard to fans such as are used on board ship?—B. E. J.

LOSSES IN STEEL FURNACES.—Could any reader kindly inform me the average per cent. of actual loss, and the average per cent. of skull, in the charge of a Siemens open-hearth steel furnace working charges of from 30 to 40 tons? And also the percentage of loss in heating slabs and ingots in the Siemens regenerative gas furnace?—J. R. R.

CUTTING CHASERS.—Can any reader inform me what method is used by Sir J. Whitworth and Co. to cut up their screw chasers, both inside and out? Or can any reader advise me as to the best method of cutting up inside and outside chasers when high-class mechanical efficiency is required, such as would be necessary in making standard gauges? Is there any method by which one can ensure a chaser retaining its proper angle after going through the hardening process?—A KIRBY.

CAMS AND BOWLS.—(1.) When subject to little pressure, studs work in the cam race without any roller or bowl on them. At what amount of pressure ought a roller to be used on the stud to work in the race? and how is the pressure on the stud to be calculated for a cam to turn rotary motion into to-and-fro straight motion if the groove or race is 12in. diameter and moves a bar 4½in. in each direction? (2.) What is the pressure on a wiper cam to lift 2cwt. at 1¾in. from shaft? and also, what is the strain on the cam shaft, and how can I find it for other wipers? (3.) What is the pressure on the ball bearing in a ball mill, and how is it found? The mill is to grind 75lb. at a time, and the ball works in a hemispherical footstep bearing and at end of inclined spindle, the top end of which makes a circle of 1ft. diameter in turning. Weight on spindle about 1 ton.—OATS.

LOCOMOTIVE CONSTRUCTION.—Will any correspondent enlighten me as to the mode adopted in locomotive work in order to fix the position of the axles (horizontally) so that each axle may have a predetermined portion of the total weight resting upon it? Say:—

Load on leading axle	.....	0·32
„ driving „	.....	0·48
„ trailing „	.....	0·20
		1·00

Of course I am aware there are certain circumstances—such as length of barrel, position of firebox, etc.—which in practice to a great extent influence this; but the point I wish clearing up is: Given the total weight, how are the positions of axles determined so that the prearranged weights rest on them? An answer would be of service to others as well as to—HILLSLAND.

Replies.

☞ Owing to the constant increase in our correspondence, we regret that we have no alternative but to announce that we cannot reply by post to Queries even when stamped envelopes are sent.

☞ Queries and Replies must in all cases be accompanied by the names and addresses of the writers, as no notice will be taken of anonymous communications.

ORIZABANA.—We cannot assist you.

H. D.—The leverage will be the same in both cases, as in your sketch.

DEMOND.—Mr. P. Pitman, Aubrey-road, Withington, Manchester.

A. E. DODD.—We fail to understand your query. Write again, and more explicitly.

OLD SUBSCRIBER.—Full instructions are given in our issues for May 18 and June 1, 1889.

ENGINE DRIVER.—See reply to "A. M." in our issue for September 23. The horse-power in your example will be about 200 I.H.P.

S. COLLEY.—We cannot add anything to the formula in the "Pocket Diary," and should not advise the use of a higher pressure.

R. L. FRYER.—There are dozens of rules for the "nominal horse-power" of engines, but there is no satisfaction in any rule of the kind.

W. MARTIN.—We do not know of any firm who make a speciality of the particular form of screw jack you describe, but think that Messrs. Tangyes Limited, Birmingham, will supply you.

A MECHANIC.—If the diameter of the wire and that of the coils of the spring are the same, the compression will be proportional to the length of wire in the spring; so that if the length of spring be doubled, the same weight will still just close the coils.

FIREMAN.—The lower end of the conductor should be buried in a pit and packed tightly round with small pieces of coke. It would be better to place the conductor wholly underground, as you suggest, but we do not think you can claim to be in any danger.

RATIO (1.) If you add another 40 H.P. engine, the combined power will be of course 80 H.P. (2.) It is not *necessary* to increase the boiler pressure, but if you can do so it will be better to make your new engine with a smaller cylinder, and work compound. (3.) If you couple the cranks at right angles, you will not need a heavier wheel.

ONE ANXIOUS TO KNOW.—One method is to mount the pulley on a true mandrel and run this on a pair of straight edges. You can try what weight is required to balance the pulley by temporarily attaching pieces of iron to the rim. A piece of soft clay is sometimes used to attach the counterweight until the correct amount is ascertained, when a piece of plate of the required weight is cut and bent to suit the inner surface of the pulley rim and secured by rivets.

ROLLING CONTACT.—Can any reader kindly inform me if there are any machines in use for any purpose which have two rollers, cylinders, or the like, revolving in opposite directions at the *point of contact*?—W.——*A.*—The querist will find a motion such as he inquires for in a small knife-cleaning machine sold by ironmongers.—J. WORRALL.

ALUMINIUM.—Can any reader inform me how I can get a brilliant polish on short aluminium tubes which have been turned in a lathe? I have noticed aluminium articles in shop windows beautifully finished, but cannot find out how it is done.—TUBAL CAIN'S SON.——*A.*—Your tubes should be finished in the lathe, taking a fine cut with a very sharp tool, using oil as a lubricant. Run moderately fast with rather a slow traverse. Polish up with No. 00 emery cloth and oil, and finish with a little whiting on a soft leather.—A. HARVEY.

Prize Competition.

WE OFFER FOUR GUINEAS MONTHLY IN PRIZES FOR THE BEST ORIGINAL ARTICLES SENT IN ON ANY MECHANICAL, ENGINEERING OR ELECTRICAL SUBJECT.

IN ORDER THAT MANAGERS, DRAUGHTSMEN, FOREMEN, AND WORKMEN WHO HAVE HAD NO PRACTICE IN WRITING MAY NOT HESITATE TO SEND IN COMPETITIONS, IT IS TO BE UNDERSTOOD THAT ALL ARTICLES WILL BE FULLY EDITED AND CORRECTED, AND JUDGED OF SOLELY ON THEIR MERITS AS ORIGINAL CONTRIBUTIONS FROM A PRACTICAL POINT OF VIEW. THE OBJECT OF THE COMPETITION IS TO INDUCE PRACTICAL MEN TO COME FORWARD AND GIVE THE RESULTS OF THEIR EXPERIENCE.

CONDITIONS.

Competitions for our Monthly Prizes must be sent so as to arrive at the Manchester Offices of THE MECHANICAL WORLD, New Bridge-street, not later than the last Tuesday in each month. Articles arriving after that time will be placed in the following month's competition.

Written competitions must be on one side of the paper only. The contributions must be original, and relate to matters connected with Engineering, Mechanism or Electricity.

The Proprietors of THE MECHANICAL WORLD reserve the right to publish any competition, whether it gains a prize or not.

The competitions may be accompanied by diagrams, sketches or drawings.

Competitors should write the words "Prize Competition" on the envelopes.

Competitors are not confined to one, but may send any number of competitions.

The correct name and address of the sender *must* be distinctly written upon every competition, not necessarily for publication. Competitions can appear under a *nom de plume*.

☞ We cannot undertake to be responsible for any MSS. sent to us, though when stamps are enclosed for the purpose we will endeavour to return rejected contributions.

Latest Inventions.

APPLICATIONS FOR LETTERS PATENT.

When Patents have been "communicated," the name of the communicating party is printed in italics.

Where complete specification accompanies application, an asterisk is suffixed.

3rd October, 1892.

17,551 MAINS for GAS or LIQUIDS. C A Mackenrot.
17,553 STEAM VALVES. J Johnson.
17,564 VALVES. J C Stewart.
17,565 PISTON for STEAM ENGINES. P Thompson.
17,567 FRICTION CLUTCHES. H E Newstead.
17,583 APPARATUS for PRESSING BRICKS, BLOCKS, and TILES. J Hamblet.
17,590 FILTERING or PURIFYING FEED WATER for STEAM BOILERS. J B Edmiston.
17,602 SAFETY DEVICES for STEAM PIPES or CONDUITS. H H Lake. (*A C W Kuhlmann*, Germany.)
17,605 AUTOMATIC ELECTRIC SWITCH. F Harrison.
17,608 UTILISING a FULCRUM and LEVER POWER by GRAVITY. G Byrne.

4th October, 1892.

17,609 STEAM JET or LIKE BLOWERS for STEAM BOILERS. W Bracewell.
17,610 IMPROVEMENTS in the CONSTRUCTION of SHIPS and OTHER METAL-PLATED STRUCTURES. H Turner and others.
17,613 HEATING of METAL for the PURPOSE of MANIPULATION. J F Hall.
17,619 EXTRACTION of COPPER from ORE. J D Gilmour and J Finlay.
17,626 RECORDING SCALES. C U Fisher. (*R McFarlane* and *W E Holmes*, United States.)
17,628 LOCKING the HEADS of SCREWS or SCREW NUTS.* L R Blumstengel and E L Roehn.
17,631 IMPROVEMENTS in CHURNS and in the AERATION, REFRIGERATION, and HEATING of LIQUIDS. A Robinson.
17,632 FIRE ENGINE MOTORS.* H G Held.
17,633 WATER PIPES. P Ovendon and H E Bunker.
17,634 ATTEMPERATORS. P Ovendon and H E Bunker.
17,635 APPARATUS for OPERATING THROTTLE VALVES from a DISTANCE. W Payton.
17,636 GOVERNORS for MOTIVE POWER ENGINES. W Payton.
17,643 ELECTRIC SWITCHES. H Edmunds.
17,647 MAGNETO-ELECTRIC APPLIANCES.* H Hylton-Foster.
17,654 RAILWAY BUFFERS. W Marshall.
17,657 APPARATUS for CLEANING OUT the HYDRAULIC MAIN WHILST at WORK. S Carpenter.
17,658 GRIPPING DEVICES for CABLE RAILWAYS.* H H Lake. (*The Vogel Cable Construction Company*, United States.)
17,661 PREPARATION of REAGENTS for WORKING GOLD and SILVER ORES. H H Lake. (*Eloy Noriega*, Mexico.)
17,663 FORCED HOT BLAST to MARINE and STATIONARY BOILERS. W Blakey and A P Rushforth.
17,666 PROPELLERS. W H Hawkings.
17,679 DEVICES for GIVING ALARM and STOPPING MACHINERY OPERATING CARRYING BANDS or CORDS. P Luhn.
17,682 PIPE WRENCHES.* J W Allen and D McLachlan.
17,688 RAILWAY BRAKE APPARATUS.* W Jacken.
17,689 WHEEL BEARINGS.* A J Boult. (*Hoerder Bergwerks und Hütten-Verein*, Germany.)
17,691 APPARATUS for CUTTING GLASS by ELECTRICITY. L Havaux.
17,692 PURIFICATION of IRON or STEEL from SULPHUR. E H Saniter.
17,694 EXTRACTION of BISMUTH. J W Kynaston.

5th October, 1892.

17,698 POLARISED ELECTRICAL INDICATOR. H F Lewis and H H Eley.
17,700 ELECTRIC ARC LAMPS. E C Russell.
17,706 AUTOMATIC FOG SIGNAL for RAILWAYS.* C H Handford and A Cooper.
17,707 CENTRIFUGAL DRUMS for LIQUIDS.* O Lentsch.
17,711 LATHE CARRIERS. T Sugden.
17,716 WINDLASSES or CAPSTANS. T M Grant and A Kelly.
17,718 ELECTRICAL and MECHANICAL TELEPHONE RECEIVERS. H Rose.
17,719 FASTENER for WIRE ROPES. H Sykes and E Jackson.
17,732 PATON'S GAS-ENGINE EXHAUST RELIEVER. A Paton.
17,733 MACHINERY for MAKING BRICKS. J Wallace.
17,739 PREPARING GUTTA-PERCHA and RUBBER for VARIOUS PURPOSES. R Hutchison.
17,740 MOULD APPARATUS for CASTING. S Alley and J A MacLellan.
17,743 ARC ELECTRIC LAMPS.* E de Pass. (*L Bardon*, France.)
17,754 MACHINE for FILING and SETTING SAWS. O A Berend. (*A Klumpp* and *G Mayr*, Germany.)
17,756 MACHINE STOKERS for SUPPLYING FUEL to FURNACES. E and A W Bennis.
17,759 WORM WHEEL. P Wallace.
17,761 ROTARY STEAM ENGINE. W W Horn. (*W B Coulter*, United States.)
17,763 APPARATUS for GRINDING GLASS.* J W Bonta.
17,773 APPARATUS EMPLOYED in COATING METAL PLATES with TIN, TERNE, or OTHER METAL or ALLOY. D R Jenkins.

6th October, 1892.

17,774 DYNAMO ELECTRIC MACHINES.* E W Cowan and W P J Fawcus.
17,775 STEAM BOILERS. A Gray.
17,780 TOOL HOLDER for MACHINE EMPLOYED for BORING, MORTISING, or TENONING WOOD. P Hancock.
17,784 DOUBLE PISTON and PISTON ROD. R E Bradford.
17,785 APPARATUS for COUPLING and UNCOUPLING RAILWAY TRUCKS. P Williams and others.
17,787 MINERS' SAFETY LAMPS.* H Hubner.
17,790 APPARATUS for USE in TRANSMITTING the POWER of STEAM ENGINES. T Dhunjeebhoy.
17,792 FRICTION CLUTCHES. H S Nicholson.
17,793 WATER DISTRIBUTING APPARATUS. J A McNaughton.
17,794 COCKS or TAPS. W Bradley.
17,795 FRICTION CLUTCHES for CONVEYING ROTARY MOTION. F L Croft and H Christian.
17,797 SCREW NUTS. R Wallwork.
17,798 APPARATUS for INDICATING the EXACT DRAUGHT of SHIPS. J B Murray.
17,800 STONE PLANING MACHINES. J G Faulds.
17,820 PULSATING STEAM PUMPS. W H Bailey and J L Berry.
17,821 TOOL and ATTACHMENT for TRUING-UP GRINDSTONES. F Mayne.
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FRIDAY, OCTOBER 28TH, 1892.

Edison and the Incandescent Lamp.

ONCE more has Edison been successful in the United States law courts. This time it is the claim to the invention of the incandescent lamp containing a filament of carbon mounted in an all-glass vacuous globe, which the Circuit Court of Appeals has sustained. The controversy just concluded has been proceeding for seven years, and now Edison is declared to be the man who first devised and gave to the world an incandescent electric lamp capable of economical use in factories, large buildings, and in smaller buildings contiguous to each other—or, in other words, available for isolated lighting. The day after the decision was rendered, Edison stated: "I have always suspected," he said, with a laugh, "that I was the inventor of the electric lamp, but now I am sure of it. It has taken just twelve years to reach a conclusion, but I guess the matter is settled now for all." The bone of contention lay in the second claim on account of the alleged vagueness of the term "filament." As paraphrased by the court this was as follows:—"The combination of carbon filamentary or thread-like in size and properly carbonised, used as an illuminant in an incandescent electric lamp, with a receiver made entirely of glass, and from which receiver the air has been exhausted to such an extent that disintegration of the carbon, due to the air, wasting action of surrounding gases, or to any other cause, is so far reduced as to leave the carbon practically stable." The method of construction is so broad as to include all forms of incandescent lamps now on the market, and puts a monopoly into the hands of the General Electric Company. On the other hand, the Westinghouse Electric Company, the opponents, who failed to break down the Edison patent with the Sawyer-Man lamp patent, have brought out a new lamp which is claimed not to infringe the Edison lamp. This new lamp is made with a stopper instead of an integral glass globe, and it is reported to be highly efficient. Though one result of the above action is to place practically a monopoly in the hands of the General Electric Company for the four years that the patent has to run, another may be looked forward to in the stimulus imparted to invention by the decision. Tesla has conducted brilliant experiments with single-rod lamps, and with those entirely free from filaments, and this field is still open to the inventive mind.

Profit Sharing.

EXPERIMENTS in profit-sharing schemes are being watched with much interest by a number of employers in this country, many of whom appear to be inclined to adopt some such plan in order to counteract in a measure the aggressiveness of modern trade unionism. About a year ago attention was called to the matter very significantly by the spontaneous offer made by Sir Alfred Hickman, M.P., to his workmen at the Spring Vale Furnaces. He then proposed to give a share of the profits made at Spring Vale between July 1, 1891, and July 1, 1892, to those men who had worked there all the year, hoping that the result would be a substantial sum for each workman, which might induce them to make an effort to lay by something against illness, old age, or temporary want of work. From a letter recently addressed to the men it would appear that the results of the first year's working are not as satisfactory as was expected, in more than one respect. After referring to the drawbacks experienced owing to the Durham strike, the diminishing prices, and increasing cost of production, the letter concludes as follows:—"Notwithstanding these drawbacks, your share amounts to 2½ per cent. upon the whole of the wages which you received during the year, and this amount will be paid to each of you on Saturday next. . . . I told you that I expected I should be repaid, at any rate some part of the amount given to you, by your increased attention, by greater care in avoiding waste, and by the natural result of a general feeling amongst you that everyone was directly interested in making the works pay. I cannot say that, except in a few instances, I have seen any evidence that this has been realised. I am willing, nevertheless, to try the scheme for another year, but whether I continue it after that time will depend entirely upon the result."

Irrigation Extraordinary.

THE climate of Southern Russia and that of Siberia is hot and dry in summer time, and rough in winter, when snow falls in considerable quantities. In summer some of the rivers become partially dry, very little rain falls, and artificial irrigation has, therefore, to be resorted to. The district of Semiretchensky, in Siberia, is particularly in need of water in summer, and a novel method of obtaining it has been adopted. The people in each village—men, women, and children—set to work immediately a heavy fall of snow occurs, and collect it. It is then conveyed to a spot previously resolved upon, on the flank of a mountain, and as much as possible at the bottom of a little valley. The snow is allowed to slide down, and is scattered and pressed into a compact mass so as to harden it. This operation is repeated at each heavy fall of snow, and when spring arrives there is a bed of snow at least 12ft. thick, and several thousand tons in weight. The snow is prevented as much as possible from melting by the laying on the upper surface of pine branches and straw, or earth and sand. A deep ditch is previously dug, and into this, when the hot weather arrives, the melted snow passes and is collected. Sluices are provided to let the required water on the land, and the surplus runs to waste. By this method the land is efficiently irrigated.

A Large Balloon.

A DONATION of £2000 made by the German Emperor to the German Society for the Promotion of Aërial Navigation is to be devoted partly to the construction and equipment of a large balloon, and partly to enable further investigations to be made into the physical conditions of the atmosphere. This balloon, as was explained on the 18th inst. by Professor Assmann, the president of the society, will be as high as a four-storeyed house and 56ft. in diameter. It will contain 2500 cubic metres of gas, and will be constructed of Egyptian cotton-stuff, covered with vulcanised rubber instead of varnish. The cost of the balloon will be £600, and of the scientific instruments to undertake meteorological observations, £400. It is intended to make ascents in this balloon to heights ranging from 28,000ft. to 33,000ft., whilst similar investigations will be made from two captive balloons simultaneously and at different but lower heights. Prof. Assmann points out that during the past thirty years no scientific operations of any importance have been conducted at great elevations; but notwithstanding this, the methods of observation have been perfected. It is expected that by the use of this new balloon, in conjunction with the other two, some further valuable results will be obtained concerning the meteorological and physical conditions of the atmosphere.

Overhead Wires and their Insulation.

VERY little is now heard of the attitude of the Board of Trade towards the electrical industry, and for that matter only one body, the Electrical Section of the London Chamber of Commerce, seems dissatisfied with a few of the regulations issued by the former since the passing of the Electric Lighting Act of 1888. The members of this section represent some of the leading electrical firms, whilst others hold aloof. This lack of unison, combined with non-participation—at least, directly—of the Institution of Electrical Engineers, somewhat depreciates the status and therefore the probable effects of the efforts of the Electrical Section. This has been shown on more than one occasion, and only as recently as Friday last, when a meeting of the section was held. Two years ago, when the Board of Trade issued regulations concerning overhead wires, a request was made for a modification of two of the rules referring to the thickness of insulation, or insulation resistance, and the suspension of the wires. No change, has, however, been made, and on the matter being referred to the Council of the Institution of Electrical Engineers, a committee was appointed to deal with the matter, and that committee met for the first time on the 20th inst. After considerable discussion a sub-committee of the Electrical Section was formed to confer with that previously mentioned, and to report progress from time to time. It was pointed out during the discussion that the Board of Trade had no business to interfere in the matter of electrical supply, except in so far as regarded the protection of the safety and of the interests of the public, and also as concerned accounts and the transfer of electrical undertakings. With this we agree; but are not the thickness of insulation of the conductors and the method of supporting the wires matters of public interest, or at least subjects of vital importance to the public? Far better it is to have a too high rather than a too low insulation, and also a more stable method of stringing the wires; and considered from a monetary point of view, we fail to see that those particular regulations of the Board of Trade hamper in any way the development of electric lighting, otherwise the progress in this branch during the past two years could not have been recorded.

Practical Electrical Units.—III.

THE VOLT—THE UNIT OF ELECTROMOTIVE FORCE.

So far we have given the most prominence to current strength, and treated it as being dependent to a great extent upon resistance, or that which impedes it. We must now, however, introduce a much more important factor than resistance—*i.e.*, electromotive force, or the electrical pressure upon which the *flow* of electricity entirely depends. At the outset it must be understood that this is a most difficult subject, and, of all others, the least understood. As we shall see, electromotive force is a phase of energy; hence it is easy to understand how the difficulty and misunderstanding arise.

Everyone knows that electricity may be produced by friction, by chemical and mechanical means, and that in each case the substance electrified is capable of doing work; in other words, electrification is accompanied by the production of energy. A rubbed glass rod, for instance, will lift light bodies and set them in motion; whilst the electricity produced by a battery or dynamo is capable of doing almost all kinds of work. Now, any body brought into such a position or condition that, in consequence, it is capable of doing work, is said to possess potential energy. This statement is most important, and, if grasped, will remove one great stumbling block to the proper understanding of electromotive force. Bodies, then, electrified, and capable of doing work, are said to have a certain potential, which means that they possess so much or so many units of potential energy. The potential, then, of an electrified body indicates the degree of electrification.

To simplify the study of potential and electromotive force, we will consider one of the sources of electricity, and explain, in plain language, the action of a simple voltaic cell, consisting of plates of zinc and copper, dipping into dilute sulphuric acid contained in any suitable glass vessel. This arrangement is represented in Fig. 2, where G is a glass vessel, Z the zinc plate, C the copper plate, H^2SO^4 the dilute sulphuric acid, and W the wire connecting the plates externally.

Now, if Z be a plate of ordinary commercial zinc, and be placed alone in the dilute sulphuric acid, it soon becomes corroded and covered with a number of bubbles, which, upon being collected and tested, are found to be of hydrogen gas. This shows that chemical action has taken place, which, if allowed to continue, will result in the formation of zinc sulphate and a decrease in the size of the plate of zinc and in the strength of the acid. If the copper plate replaces the zinc plate, no such action is observed, whilst if both plates be inserted and the upper ends of the plates be connected by means of the wire, as shown in the figure, we shall notice that the bubbles are formed on the zinc plate and pass over and collect on the copper plate. We have just shown how zinc sulphate may be formed, and that its formation depends upon the expenditure of zinc and sulphuric acid. This, of course, corresponds to an expenditure of energy which is transferred from the zinc, and part at least spent in forming another substance: and in this way we see how bodies have stored up in them a certain amount of energy, which by various and suitable means may be withdrawn and transferred, or used as desired. But the energy withdrawn in the above case is only partly absorbed in the formation of zinc sulphate, for by means of very delicate instruments we can prove that electrification has taken place on both plates (the wire W is supposed to be removed), and that a difference of electrical condition has been produced between the zinc and copper plates, corresponding to the portion

of chemical energy thus transferred. In this case the difference of electrical condition is very small, and the potential of the plates, considered separately, different in degree. It may also be shown that on the end of the copper plate outside the liquid the charge is positive, and on the end of the zinc outside the liquid the charge is negative. It will also be well to point out here that the electric potential of the metals in degree depends upon the combination of the metals used in connection with the exciting liquid used.

Now, one of the most elementary principles in electricity states that charges of positive and negative electricity readily combine and neutralise one another if suitable means exist for them doing so, and as a consequence their bodies regain their normal unelectrified condition. One of the readiest means of bringing this about in our case is to connect the two plates by the wire W, and the tendency of the two electricities to unite produces a rush, as it were, of electricity along the wire. But what causes this rush? We have already pointed out that the potential of one plate is higher than that of the other, and by means of an analogy we shall see that the tendency of a difference in potential is to cause motion from the one of higher potential to that of lower potential. It is obvious that when the stop-cock is turned so as to allow water to flow along the pipe connecting two cisterns fixed at the same height, and so filled that the level of the water in one is higher than in the other, water will flow from the cistern with the higher level to that with the lower level until the level is the same

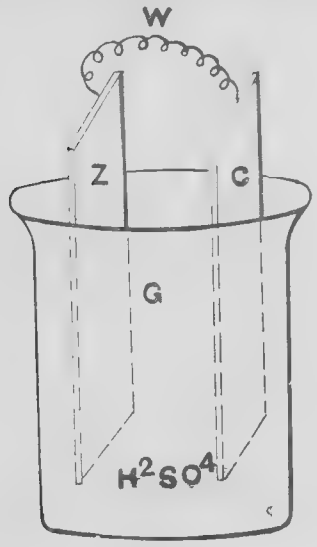


Fig. 2.

in each. In fact, the flow is caused by the difference of level in the two cisterns. In more exact words, the water in each cistern possesses a certain amount of potential energy proportional to the head or height of the water above the pipe; and as the water is at two levels in the two cisterns, there is a difference of potential between the two, and it is the difference of potential, or difference of pressure, which produces the flow. So it is with the charges on the copper and zinc terminals. There is a difference of potential between them, and, as a consequence, there is a flow of electricity from the copper to the zinc, the function of which is the neutralisation of the plates. It is probable that, as the rush of electricity also takes place in the liquid from the zinc to the copper, renewed chemical actions and reactions are set up between the plates and liquids, and fresh charges given to the ends of the copper and zinc plates, which again results in another equilibrating rush of electricity. These changes continuing in rapid succession, give rise to the flow of electricity, which constitutes a continuous current, the flow being produced by the difference of potential between the terminals of the plates. This difference of potentials is the electrical pressure to which we have already referred as electromotive force (this term is usually abbreviated by using the letters E.M.F.), and which, as we have shown, is dependent upon the amount of zinc deposited as zinc sulphate, corresponding to a certain amount of chemical energy, just as the consumption of a certain amount of coal corresponds to a certain amount of energy given forth in the form of heat. We thus see that the chemical energy, or energy of combination or separation given up by the zinc, has simply changed its form and now appears as electrical energy, the production of which always corresponds to an expenditure of a corresponding quantity of energy in some other form.

From what has been said it is clear that E.M.F. is a force setting or tending to set up that motion known as a current of electricity, and it also appears that the difference of potential between the charges on the copper and zinc plates is the same as the E.M.F. between them, and the measure of the one is the measure of the other. Energy, being capacity for doing work, is measured by the number of units of work done, and the difference of potential between the two plates is equal to the number of units of work done by the force of electricity on the positive charge of electricity in forcing it once completely round the circuit. The practical unit of E.M.F., however, is the volt, which we shall presently define in terms of the ampère and ohm; for the present it will be sufficient to point out that the E.M.F. of Daniell's cell is approximately 1 volt. As the E.M.F. of large dynamos is frequently very high—in some cases 10,000 volts are generated—it is now common to use the term "voltage" instead of E.M.F., when speaking of the E.M.F. of a dynamo.

As we have introduced three terms—difference of potential, E.M.F., and voltage—apparently for the same thing, it will now be necessary to distinguish between the use and misuse of these terms. One—difference of potential—being used only in theoretical considerations respecting the nature of electric forces, we can dismiss it at once and consider the advantages of having two separate terms—E.M.F. and voltage—to use practically for different phases of electrical pressure—*i.e.*, the electrical pressure *generated* and the electrical pressure *used* in the external part of the circuit. We cannot too strongly at this point urge upon engineers to accustom themselves to use *E.M.F.* exclusively as a measure of the electrical pressure *generated*, or the total electrical output of a dynamo or battery; and *voltage* as the measure of the electrical pressure *at the terminals*, and used externally, or the useful output of a dynamo or battery.

"The term E.M.F. should be reserved for the energy supplied, while the distribution of energy can be denoted by voltage. The voltage can always be measured by a voltmeter, but E.M.F. cannot always be so determined. Voltage must be caused by E.M.F., but E.M.F. may exist without voltage. E.M.F. is generally local, while voltage is necessarily distributed. E.M.F. represents a condition of supply which is generally fairly constant, however much power is supplied."

(To be continued.)

Recent Boiler Explosions.

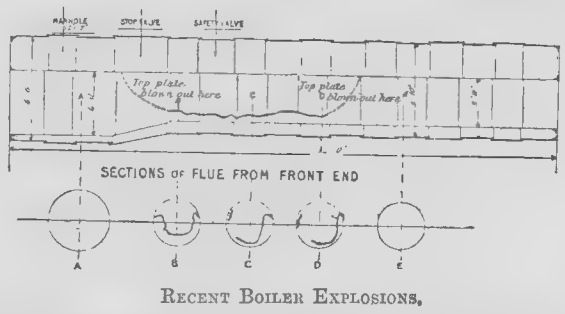
(Continued from page 107.)

No. 557 is an investigation into an explosion of a somewhat serious nature, in the course of which some rather extraordinary facts were elicited. The boiler was purchased without examination of any kind, being bought as it lay on a lurry at a railway station. After the boiler had been at work some time it was proposed for insurance, and after a considerable time and some little trouble the owners were induced to give an opportunity for a thorough examination, which was made, revealing certain defects which the insuring company said should be remedied, which repairs, however, were never carried out. A local boilermaker was called in to test it by hydraulic pressure to 165lb.—rather a high test for a boiler originally intended for 60lb. pressure. When asked why 165lb. was fixed as a test pressure, the boilermaker (who was said to have had 46 years' experience) could give no reason, only that he wanted to see at what pressure it would give out. The person who had charge of the boiler, described as "a lad 15 years of age, who had suffered from inflammation of the brain, and appeared to be of weak intellect," lighted the fire, and shortly after the boiler burst. At this investigation it was shown most conclusively that an insurance company have a monetary risk only, and that the fact of being insured does not lessen the responsibility of the owner, who, in this case, was fined £50 for not heeding the insurance company's advice and giving the boiler better attention.

Report No. 558 refers to a very minor explosion, in which a small hole was caused by corrosion in the bottom of a steam receiver, causing no damage whatever.

No. 559 is the report of an explosion of a small vertical boiler on board a fishing boat. The failure occurred at the base of the firebox where it is flanged out to the shell, and consequently must be reduced in thickness. No person was injured, or damage done, beyond the fracture referred to.

No. 560 refers to an explosion on a steamship. One of the tubes had become defective and was removed, and a new tube not being at hand, a cover was placed over each tube hole, and a long bolt passed through from one end to the other. This bolt failed, thus allowing the contents of the boiler to be discharged through the two tube holes. One man was badly scalded, but fortunately recovered.



Recent Boiler Explosions.

Report No. 561 is one which, when carefully considered, shows unmistakably that if externally-fired boilers are to be used with any amount of safety they must be fed with clean water. The boiler under consideration was an externally-fired multitubular boiler with flat ends; thus any deposit which might form would be in the shell bottom, as well as any that might fall from the tubes; consequently the intense heat of the fire would be likely to cause overheating in the neighbourhood of the deposit. In this case the plate bulged downwards and rent—fortunately, only locally.

No. 562 records particulars of the explosion of a vertical boiler, the firebox of which collapsed and rent owing to its having become so thin that the general thickness could only be estimated at about $\frac{1}{16}$in. to $\frac{1}{8}$in., as shown by cutting several holes in different places. Had the boiler been insured or under inspection, this would have been detected long before it could have become serious. As it was, the owner knew nothing about boilers, and on the grounds of such ignorance was excused.

No. 563 is an inquiry into the blowing out of a smoke tube in a marine boiler. It is not uncommon for these tubes to leak, but it is very rare indeed that they blow out endwise, as this had done. The tubes had been leaking some time, and caused not only inconvenience to the men, but unfortunately the death of the two engineers.

No. 564 refers to an occurrence which may or may not have been an explosion. Water was seen spurting from a waste pipe connecting the boiler blow-off pipe to the cock on the ship's side, eventually filling the ship and causing her to founder in deep water. There are consequently only statements of unpractical men to guide the council in the inquiry.

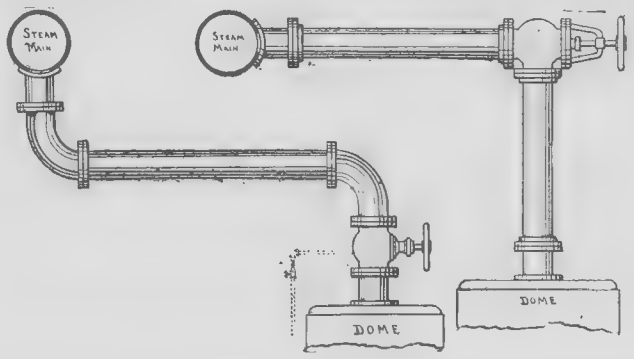
No. 565 refers to a boiler made 32 years ago, apparently of common material, and not of the best workmanship. This was allowed to work at 60lb. pressure, which is more than double what any prudent insurance company would allow; while the Board of Trade would certainly not have permitted 15lb. An old fracture running in a *circumferential* direction was found after the explosion, and to this the explosion or collapse of flue was attributed. In our opinion nothing could be more wide of the mark, but as it appeared a neat way of arranging the onus of responsibility, and the fireman was killed, it was allowed to pass. See sketch, from which our readers can draw their own conclusions, bearing in mind the great age of the boiler (32 years) and that it was 44ft. long by 4ft. diameter by $\frac{5}{16}$in. plates, and had been frequently repaired.

(To be continued.)

The Arrangement of Steam Pipes.

We have from time to time called attention to the importance of suspending and securing steam pipes properly, and providing for their expansion and contraction. In this article we wish to call attention to a common but dangerous method of connecting boilers with main steam pipes.

Fig. 1 shows the way in which the connection is frequently made, the stop valve being near the boiler, and the pipe entering the steam main from below. The action of this arrangement is as follows: The boiler being out of use, entrained water from the other boilers in the battery, as well as water of condensation, settles in the space between the stop valve and the steam main. Then, when the boiler is put in use again, in order to prevent any sudden strain from being thrown on the boiler, the stop valve is not opened until the pressure in the boiler has risen slightly above that in the main steam pipe. When it is opened there is a sudden outflow of steam, which raises the water in the connections, throws it against the first elbow, and, if that does not break, hurls it the full length of the horizontal pipe against the second elbow, and then up into the main steam pipe. The shocks so produced are greater than would be imagined by one who has not had experience with water hammers. In one case that came under our notice recently, three elbows were fractured in succession from this cause. When the first one broke, the superintendent of the mill considered that



Arrangement of Steam Pipes.—Figs. 1 and 3.

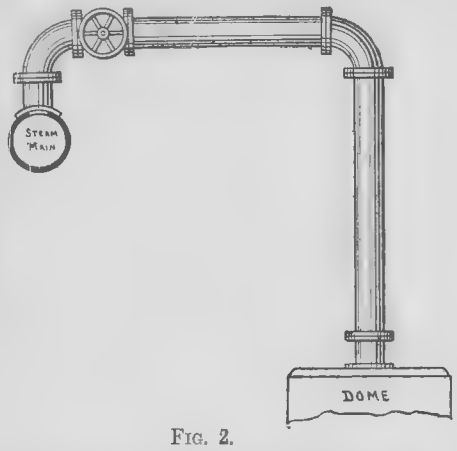


Fig. 2.

there must have been a flaw in it. It was replaced by another, which lasted only a few days. A third elbow was put in, with a precisely similar result, and by that time the superintendent had become satisfied that something was wrong with the arrangement of the piping. The defect was pointed out to him, the pipe was rearranged, and there has been no trouble since.

It might be said that the stop valve should be opened when the pressure in the boiler is just equal to that in the main. This is true; but it is not easy to determine with any degree of precision when these pressures are equal, and the engineer very properly prefers to err on the safer side, and have his boiler pressure a trifle too great, rather than too little.

The danger may be greatly lessened by putting in a drip pipe, as shown by the broken lines in Fig. 1. The drip should enter the valve at as low a point as possible, and care should be taken, when the idle boiler is about to be thrown into use, to blow all the water out through the drip pipe immediately before opening the

main stop valve. If this were carefully attended to each time, the arrangement of piping shown in Fig. 1 should give no trouble; but it is a matter of every-day experience to find engineers, who perhaps do not fully recognise the importance of the drip pipe, growing somewhat careless about it. After they have used it conscientiously fifteen or twenty times, there is a tendency to slight it a little, and open the main valve before the water is all out. If no trouble results, this is apt to fix itself on the man as a habit; and some day, when he is in a hurry, he may pay no attention at all to the drip, but open the main valve at once, exposing himself to the danger described above.

It is a far better plan to fix the pipe right and do away with the drip. A proper arrangement of the connections is shown in Fig. 2. The piping passes up above the steam main, which it enters at the top, and the stop valve is placed in the horizontal part of the connection, and as near the steam main as it can be conveniently fixed. It will be seen that with this arrangement there is no possibility of trapping water. The entire connection from boiler to main remains dry, and no water-hammer action is possible.

Fig. 3 shows another way of arranging the connection so as to avoid the trapping of water. In this arrangement the pipe enters the steam main at the side, the elbows are done away with, and an angle valve is used to connect the horizontal and vertical pipes. A perspective view of this method of connection was given in the "Locomotive" for May, 1892, on page 66. When new work is being put in, we usually recommend the arrangement shown in Fig. 3; but if the piping has already been put up in the manner shown in Fig. 1, or in any similar manner that involves the same element of danger, the arrangement shown in Fig. 2 is cheaper to put up, because it enables one to use the same valve that was in use before.—"The Locomotive."

Death of Sir James Farmer.

We regret to have to record the death of Sir James Farmer, the founder of the well-known firm, Sir James Farmer and Sons, engineers, of Salford, Manchester. The leading manufactures of the firm are bleaching and cotton spinning and weaving machinery; but in recent years they have largely developed a new department in the production of machinery and apparatus for sewage utilisation and disposal. Sir James became a member of the Corporation of Salford in 1864, and from the first he took a great interest in the water supply of the borough, his engineering training giving him special knowledge on the subject. In November, 1864, immediately after his election, he was placed on the Water Committee, and two years later he was elected chairman of the committee. He was knighted in 1887.

Hull and District Institution of Engineers and Naval Architects.

The first general meeting of the members of the above institution took place on Monday, the 17th inst., in the society's rooms, Parochial Offices, Bond-street, Hull, when the president, Mr. Spear, delivered his inaugural address. He pointed out how dependent the society was upon the reading of suitable papers and the discussions they provoked, and urged the members to contribute to the success of the society by reading papers. Proceeding, and dealing with general marine engineering matters, he pointed out the economy of triple-expansion engines over the compound type; the difficulties experienced with steel boilers working at high pressures, and the advantages that might be derived by substituting tubulous boilers (Babcock and Wilcox type). Amongst other points upon which the speaker touched were the deterioration of boilers and the methods adopted for their preservation; Serves' patent ribbed tubes; designs of boilers; forced draught and its advantages; the relative merits of piston valves and flat slide valves; improvements in the economy of steamship propulsion, and the various materials now in use for propellers; iron versus copper steam pipes; electric lighting of vessels, etc., etc. The whole formed a very interesting address, and one productive of much discussion. The following gentlemen took part in the discussion which followed:—Messrs. W. B. Dixon, F. H. Pearson, J. R. Smith, W. Harris, J. Innes, J. H. Leetham, R. Carson, H. F. Fourney, and G. H. Strong. A hearty vote of thanks was accorded Mr. Spear for his very able address.

Engineering Pattern Making.

By a Foreman.

XXVI.

The various methods by which the more ornamental parts of the pattern are produced having been given, the other portions, as the mouldings, may now be dealt with as follow:—A mould or section (Fig. 166) will require a block on which to be "run up." This section, the outline of which represents the outside of the mould, is set out upon a piece of thin sheet zinc.

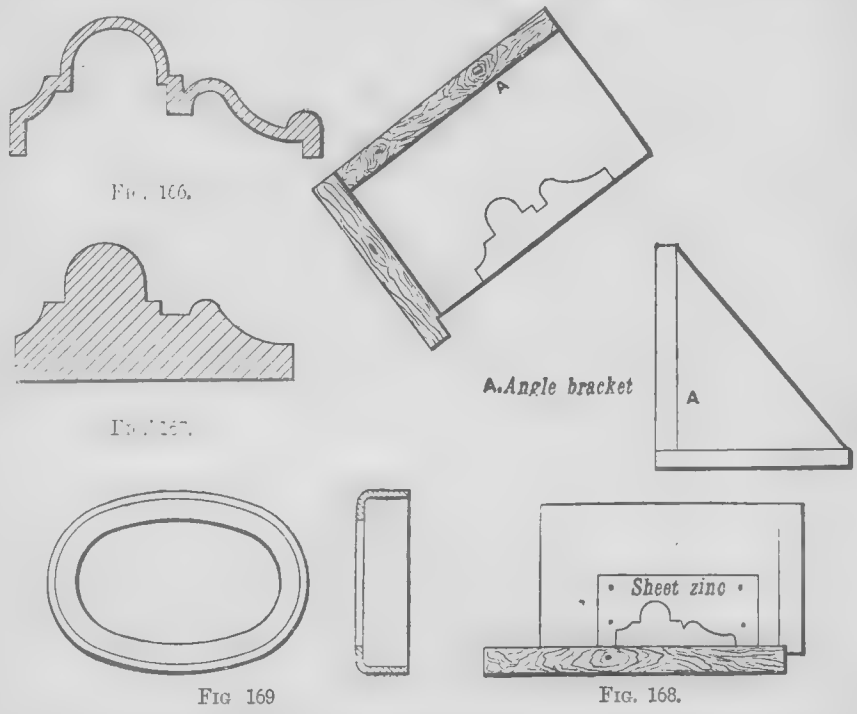


Fig 169 Fig. 168.

The part sectioned in Fig. 167 is then cut away, and the outline finished with smooth files. In order to ensure a uniform thickness, a second piece of the zinc is placed behind the first, a few fine screws passing through both thicknesses into the timber forming the strickle. By the use of the screws the templets may be used alternately, if a radial or curved piece of mould be required as well as straight lengths.

A straight piece of mould is "run up" on a piece of timber of a sufficient thickness to prevent it being affected by the moistened plaster, the water from which it will readily absorb unles the board be lightly varnished over, as before mentioned.

A strickle for plaster work differs slightly from that of Figs. 7 and 8 as used for loam on cast plates in the making of pipes, etc., as the lightness of the metal as represented by the plaster would not allow of any variation which might possibly occur with a strickle such as that to which reference has been made. It is therefore necessary to support the strickle and ensure its rigidity by means of a piece of timber set at right angles to the face of the strickle, and rebated on one edge about ½in. each way, the two pieces being secured by an angle bracket screwed to both, as shown at Fig. 168. This constitutes the strickle for straight lengths of moulding, and with the application of a little tallow on the rebated edge, and a small amount of care in the working, uniform and smooth mouldings may be run up of almost any section. The strickle should be kept clean when in use by frequently washing in a bucket of water, which must be at hand for the purpose, especially if a long length is being run up; and though the superfluous plaster (which is removed as the strickle is pushed along) is picked up by the fingers to be smeared on those parts of the moulding which are faint or uneven, there still adheres to the strickle a certain portion which, if allowed to become hard, drags off and destroys the smoothness of the work. Radial work may be struck up as in loam, the vertical spindle being, of course, much lighter; one of ¾in. diameter is perhaps the most useful, with a collar about a couple of inches from one end, and this length beyond the collar screwed so as to allow of its being tightened by a nut from the underside of the surface board on which spindle is fixed. The usefulness of a light spindle of this description cannot be over-estimated, as by its aid many temporary jobs can be got out more rapidly than they could be built up with timber segments and turned in the lathe.

A further advantage is apparent when a segment of a circle or as much as the half of one is required. The difficulty of working or turning either of these in timber as compared with this method will be easily understood when the pattern is wanted urgently. In the making of an elliptical cover as shown at Fig. 169, or a mounting (Fig. 170), a modification of the arrangement at Fig. 19 may be substituted by inserting pegs in the edge of the strickle, to slide up and down the grooved plate, which should be fastened down within the elliptical figure.

The dummy or block representing the inside of the cover (Fig. 169) will require a strickle to form the outside and rounded edge; the inside may be of irregular shape, but clear of the grooved plate, so that perfect freedom of movement is ensured for the dummy strickle and the one giving the thickness.

The mounting (Fig. 170) should have the inside and the outside run up at separate times; the inside first, as some difficulty will be experienced if the full thickness A to B is tried at one operation, and though the former plan will necessitate the making of separate strickles, the difference of time and the improved results will more than compensate for this.

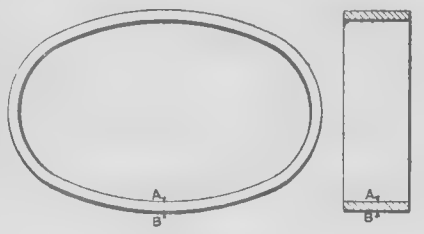


Fig. 170

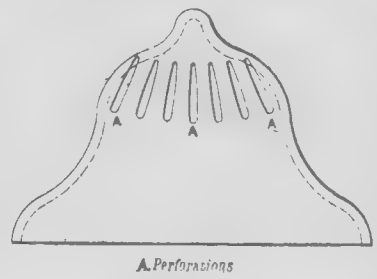


Fig. 171

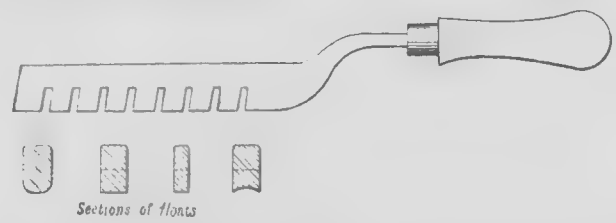


Fig. 172.

The common boiler for domestic purposes is a very plain illustration of the advantage of plaster of Paris as a material from which to make a large but very thin pattern, yet only intended to be used for the production of one in metal for the working pattern. The perforated dome, Fig. 171, is another instance of the application of this material. Two strickles will be required, one for the block, the other for the thickness, the radial slots being set out and cut through the plaster pattern after it is set. Among the other tools used for this particular work, the "floats" shown at Fig. 172 are for dressing off and finishing the different parts and sections which have been cast in the "compo." metal, and are afterwards connected by means of the soldering iron and soft solder.

To the ordinary pattern maker the use of the latter would feel somewhat out of place at first, and rather difficult to manipulate; but a little practice will enable him to make a tolerably neat joint of the several sections after a few trials. Before bringing to a close these remarks on the use and application of plaster of Paris, it will be well to give an example of how an elbow pipe or bend is made in this material. The one we shall take is such as would be used to couple up to a straight length, and made specially light for the conveyance of water only.

(*To be continued.*)

Technical Education: Its Use and Abuse.*

Professor Smith divided the whole of education into three stages: (1) Preliminary and general; (2) Special—*i.e.*, professional or technical; and (3) The subsequent training received through the experience of practical work and life. The third stage was the most important, not only as being longer and more difficult, but also as affording wider opportunities. He next insisted strongly on making the initial stage liberal and general in character, and of continuing it until the age of at least 13 for relatively poor boys and girls, and to from 15 to 18 for those better off. He complained of the one-sided nature of the teaching of the present school system, and said that it required development not only on the natural science side, but also in the direction of training in skilled natural labour. He did not much care what kind of labour was employed as the means of this training, but he insisted that it was a viciously narrow and illiberal training that made no effort to cultivate among all classes an intelligent comprehension of, and sympathy and respect for, what must remain the life work of the vast bulk of mankind.

The object of such teaching of manual work was distinctly liberal, and it should be counted quite as needful a part of general education as the literary, mathematical, scientific and artistic portions of the curriculum.

In the subsequent technical teaching he referred chiefly to what was needed by the artisan population; and repudiated the claim to be called technical schools, of those where nothing but science and vague generalities regarding the applications of science to industry were taught.

The detailed study of the materials, appliances and methods of one or other set of industries was the proper object of a technical school; and this study should be as scientific as the contemporary development of science permitted, but it must leave science behind wherever science has not followed the actual advances made by industry. Many faculties necessary for success in industry could be gained only by training in works, but a great deal of the skill and knowledge necessary for the conduct of industry can be obtained in a well-managed school. Such a school may do useful work under certain conditions and certain limitations—namely, its teachers must have, in works, obtained a thorough first-hand knowledge of what they teach, and must also be men of first-class general and scientific education; secondly, a sufficient time must be allowed for the influence of the school to work on each individual student; thirdly, the school must be materially well equipped. The unavoidable limitations referred to this third condition, because schools would never be furnished with large-sized apparatus, nor apparatus to deal with large masses of material, while the properties and actions of large masses and large machines were often very different from those of small masses and machines.

* Abstract of the Opening Address (Session 1892-93) to the Mason College Engineering Society, by Professor R. H. Smith.

Professor Tilden, in moving a vote of thanks to the author, said that Professor Smith's views on the subject were quite in accord with his own. Many of the technical questions we were now trying to solve had been already solved in Switzerland and elsewhere, but at present the whole question in England was in a chaotic state, from which, however, it was to be hoped that we should emerge with a better system. He pointed out the necessity for higher education being given to selected individuals from the artisan class, the difficulty being to find a means of selecting those worthy of receiving such training from amongst them. He did not think we had, as yet, found the proper means of doing so.

Dr. McCarthy seconded the vote of thanks. He could only view this question from rather a limited standpoint—namely, that of technical teaching of children in the Board Schools. This had been attempted in Birmingham at the Bridge-street Schools, and would also be tried at Small Heath on a larger scale. They hoped by this means to give some small insight into the fundamental notions of technical education, but must leave the further development to other institutions, such as the Municipal Technical School, the Midland Institute, and Mason College. He admitted that the right method of selecting boys worthy of receiving the higher education referred to by Professor Tilden had not yet been discovered. They were trying to solve this problem, but perhaps it was impossible to gauge the capacity of a scholar at 13 years of age.

Mr. J. Watkins supported the vote of thanks. In his opinion the present system did not go far enough; it was no good telling a boy about the working of machines. What was wanted was that they should, under able supervision, work with the actual machines.

The resolution was also supported by Messrs. Thornbery, Barnby, Muirhead, Richardson, and Mr. Jones, Director of Technical Education in the County of Staffordshire.

The vote of thanks was carried unanimously.

Professor Smith, in returning thanks, said that it was necessary to make a distinction in the technical education given to the master and to the artisan, but that it was of great importance that the workman should receive some such education. In many cases valuable inventions were due to the workman.

Shipbuilding Notes.

Messrs. Scott and Co., Greenock, launched, on the 20th inst., a steel screw steamer for the Ocean Steamship Company, Liverpool. The dimensions are:—Length, 354ft.; breadth, 42½ft.; depth (moulded), 30ft.; and of 3600 tons. The builders will supply triple-expansion engines of 2000I.H.P.

There was launched on the 18th inst. from the shipbuilding yard of Messrs. Workman, Clark and Co. Limited, Belfast, a large steel sailing ship, built to the order of Messrs. Galbraith and Moorhead, of London. The dimensions are:—Length, 284ft.; breadth, 42ft.; depth, 25ft.; gross tonnage, 2250; register tonnage, 2160; deadweight capacity, 3680 tons.

M. Normand, of Havre, has undertaken for the French Government a 144ft. torpedo-boat, the "Chevalier," with which he guarantees a speed of 25 knots, and hopes to attain between 26 and 27 knots. The displacement will be 123 tons, or about four tons more than that of the "Dragon," which, though only guaranteed to do 20·5 knots, did 25 knots the other day at her trials.

Messrs. R. and W. Hawthorn, Leslie and Co. launched, on the 20th inst., from their shipbuilding yard at Hebburn, a large steel screw steamer, built to the order of the Great Northern Shipping Co., of Newcastle. The dimensions are:—322ft. by 41ft. 6in. by 24ft. She is fitted with triple-expansion engines, having cylinders 23½in., 39in., and 64in. diameter, by 42in. stroke, which will drive her at a speed of 10 knots with 4600 tons deadweight.

On the 20th inst. there was launched from the yard of Messrs. John Blumer and Co., Sunderland, the steel screw steamer "Chicago City." Her dimensions are:—Length, 306ft.; beam, 39ft.; depth, 25ft. 9in. moulded. The engines and boilers are being constructed by Messrs. Blair and Co., of Stockton, the engines having cylinders 23½in., 39in., and 64in. diameter, by 42in. stroke. The boilers are of steel, having a working pressure of 160lb. per sq. in.

The new first-class cruiser "Blenheim" underwent her forced draught trial at the mouth of the Thames on the 20th inst., to determine the acceptance of her machinery from Messrs. Humphrys, Tennant and Co., the contractors. The horse-power required under the contract was 20,000, which was considerably exceeded, the mean for the four hours' run being 21,411H.P., this being obtained with the engines averaging 105 revolutions per minute. The speed by the patent log for the four hours' run was 86·4 knots, giving an average of 21·6 knots. The engines and boilers worked very successfully throughout the trial.

The Chemical Examination of Boiler Feed Water.—III.

[CONTRIBUTED.]

Estimation of the Potash and Soda.—Concentrate 1000cc. of the water by evaporation to about 50cc., to the solution add about 2grms. of caustic baryta, heat to boiling for 10 to 15 minutes, filter off the precipitated carbonates, hydrate of magnesia, etc., and wash. To the filtrate add excess of ammonia, then ammonium carbonate solution, and a few drops of ammonium oxalate solution. Bring the solution to boiling, and after allowing to settle, separate the precipitate thus obtained by filtration, receiving the filtrate in a platinum dish, and wash. Evaporate the filtrate, which contains the potash and sodas in the form of chlorides, together with ammoniacal salts, to complete dryness, and ignite very gently to expel the ammoniacal salts. The ignition must be performed at a very dull redness; a higher temperature would occasion loss by volatilisation. Treat the cold residue with a small quantity of water, filter if necessary, acidify with hydrochloric acid, and evaporate to dryness in a weighed platinum dish. Gently ignite the dish and contents, allow to cool in the desiccator, and weigh the alkaline chlorides.

To separate the alkalies, dissolve the mixed chlorides, after weighing, in a small volume of water, add a small quantity of platinum tetrachloride, and evaporate on the water bath to a pasty condition. Pour on the residue some methylated alcohol, gently rotate the dish so as to mix the contents uniformly, allow the precipitate to completely settle, and pour off the liquid through a weighed filter. Repeat the digestion with fresh alcohol some three to four times, decanting and passing through the filter as before, and finally transfer the undissolved residue to the filter by means of a small wash bottle filled with alcohol. Wash the filter and contents with alcohol until the washings are no longer coloured. Now dry the filter and contents in the water-oven, and weigh the double chloride of potassium and platinum (K_2PtCl_6). The weight of the K_2PtCl_6 thus found multiplied by 0·3070 will give the potassium chloride (KCl), which, deducted from the weight of the mixed chlorides obtained above, will give the sodium chloride (NaCl). Then calculate into oxides as follows:—

KCl × 0·6308 × 70 = grains of potassium oxide (K_2O) per gallon.
NaCl × 0·5299 × 70 = grains of sodium oxide (Na_2O) per gallon.

Determination of Hardness.—The hardness—that is, the soap-destroying properties—of a water is of two kinds—viz., temporary and permanent. Temporary hardness is due to the presence of the carbonates of lime and magnesia, and may be removed by boiling the water; while the permanent hardness is due to the presence of sulphate of magnesia, and is not removed by boiling. The hardness of a water is determined by ascertaining the amount of a standard soap solution required to produce a permanent lather with a known volume of the water, and is usually expressed in terms of grains per gallon of calcium carbonate. The method, due to Dr. Clark, requires for its performance the following solutions:—

Standard Solution of Calcium Chloride.—Dissolve 1·11grm. of pure fused calcium chloride in a little water, and make up the volume with distilled water to 1000cc.; or, dissolve 1grm. of pure carbonate of lime in 10cc. of hydrochloric acid, and evaporate the solution to dryness. Dissolve the mass in water, again evaporate to dryness, and repeat the operation once more. Finally dissolve in water, and make up the volume to 1000cc. 1cc. of either of these solutions is equivalent to 0·001grm. of carbonate of lime.

Standard Soap Solution. — Dissolve 13grms. of sodic oleate in a mixture of 500cc. of methylated alcohol and 500cc. of water; allow to stand for some hours, and filter if necessary. Now proceed to standardise the solution in the following manner:—Into a glass-stoppered bottle of 250cc. capacity, run in 12cc. of the calcium chloride solution, and make up the volume with cold distilled water to 70cc. The water employed in making and diluting the solutions should be freshly boiled (to expel carbonic acid) and quickly cooled. Fill a burette, graduated in one-tenth cc., to the zero mark with the soap solution, and allow to run into the bottle 1cc. at a time, vigorously shaking the bottle after each addition, until a uniform lather is obtained, which remains permanent for three minutes, when the bottle is laid on its side and allowed to remain undisturbed. Upon the completion of the operation note the cc.'s of the soap solution used, which, if it is of standard strength, is 13cc.—that is, 12cc. for the 12cc. of calcium chloride taken, and 1cc. required by the distilled water employed to produce a lather. Should the soap solution be too strong, as will be the case, more dilute alcohol—1 part alcohol to 1 of water—is added, until 12cc. of the calcium chloride solution require 13cc. of the soap solution to produce a permanent lather. If it is too weak, a correction is made.

Estimation of Total Hardness.—Place 70cc. of the clear water under analysis in the stoppered bottle, vigorously shake, and remove the carbonic acid by sucking out the air from the upper part of the bottle by means of a glass tube. Now run in the soap solution in the manner above described, until a uniform lather, remaining for three minutes, is obtained. The number of cc. required, minus 1cc. for the distilled water, gives the hardness in grains per gallon of carbonate of lime, or degrees Clark.

Should the water require more than 16cc. of the soap solution, dilute 35cc., or any other suitable volume, with distilled water to 70cc., and proceed as before; and in calculating the results multiply the volume of the soap solution used by the number expressing the fraction of 70cc. taken.

Permanent Hardness.—Heat 500cc. of the clear water to boiling for about an hour, replacing the water as it evaporates with distilled water, after which allow to cool, pass through a dry filter, make up to the original volume (500cc.), and determine the hardness on 70cc., as before described.

Temporary Hardness.—This is obtained by deducting the permanent from the total hardness.

Reporting the Results.—In reporting the results of the analysis, it is preferable to return the acids and bases—the latter as oxides—separately, and not in a state of combination. If the latter plan is adopted, some such method as the following is used:—

Unite the chlorine with the soda, if any remains in excess, then respectively with the potash, magnesium, and calcium; the sulphuric acid with potash and soda—provided there is not sufficient chlorine to satisfy them,—then with the calcium, and finally magnesium. Any calcium and magnesium remaining in excess are returned as carbonates; and the silica, oxide of iron, and alumina as such.

The following is an example of the manner in which the acids and bases are combined. The analysis gave the following:—

	Grains per Gal.
Silica, oxide of iron, and alumina	0·80
Lime (CaO)	7·17
Magnesia (MgO)	2·91
Soda (Na_2O)	2·623
Sulphates (SO_3)	8·90
Chlorine (Cl)	3·01

To facilitate the calculations, the above are expressed as under:—

	Grains per Gal.
Silica, oxide of iron, and alumina	0·80
Calcium (Ca)	5·12
Magnesium (Mg)	1·74
Sodium (Na)	1·95
Sulphion (SO_4)	10·69
Chlorine (Cl)	3·01

which may be combined as follows:—

Na. NaCl. Na.
23 : 58·5 :: 1·95 : x = 4·69 grains of NaCl per gal.

SO_4 $CaSO_4$ SO_4
96 : 136 :: 10·69 : x = 15·14 „ $CaSo_4$ „

$CaSO_4$ SO_4
15·14 − 10·69 = 4·45 Ca used.

Ca. Ca.
5·12 − 4·45 = 0·67Ca to combine as $CaCO_3$

Ca. $CaCO_3$ Ca.
40 : 100 :: 0·67 : x = 1·67 grains of CaCO per gal.

Mg. $MgCO_3$ Mg.
24 : 84 :: 1·74 : x = 6·09 „ $MgCO_3$ „

TABULATED RESULTS.

	Grains per Gal.
Silica, oxide of iron, and alumina	0·80
Sodium chloride	4·69
Calcium sulphate	15·14
Calcium carbonate	1·67
Magnesium carbonate	6·09
	28·39

Rapid Method of Analysis.—By the following method, a very fair knowledge of the inorganic constituents of a water may be readily obtained:—

Take a litre of the water (should the sample hold matter in suspension, the filtered water is used) and heat to boiling in a large beaker, until the volume is reduced by three-fourths, whereby the carbonates of lime and magnesia are precipitated. Collect the precipitated carbonates on a tared filter paper, wash with water, dry in the water-oven, allow to cool, and weigh to determine the increase due to the carbonates, and multiply by 70 to convert into grains per gallon.

Evaporate to dryness, contained in a small porcelain dish, the filtrate remaining from the above determination, and digest the dry residue at a gentle heat with methylated spirits. This dissolves the whole of the constituents of the residue, with the exception of the sulphates and the small quantities of silica, oxide of iron, and alumina usually present. Pass the alcoholic solution through a tared filter paper, wash with alcohol, dry, and weigh. The increase in weight is equivalent to the sulphates, plus the small quantities of silica, etc.; multiply by 70 to bring into grains per gallon.

Evaporate to dryness the alcoholic filtrate, obtained as above, contained in a small tared porcelain dish, and heat in the water-oven until a constant weight is obtained. The excess above the weight of the dish gives the chlorides and nitrates. Calculate into grains per gallons by multiplying by 70.

By this method, the "temporary hardness" (from the carbonates), the "permanent hardness" (from the sulphates), and the other soluble mineral constituents of the water, are roughly obtained.

Chuck Drills.

WHILE not of the rotating class of tools chuck drills may be properly considered with other forms of drills, as they partake of the same general qualities. The cutting edges, their angle, clearance, etc., are practically similar to those of ordinary drills, with the exception of the absence of the point from the larger sizes, or more properly, the comparatively larger, as it is governed more by the size of the lathe than of the drill. When it is necessary to start a hole in the solid metal, of course a pointed drill is necessary, but for all sizes following, or all which are to be used in a drilled, cored, or punched hole, the point is superfluous, and only makes so much unnecessary grinding. It is much the best plan to make all chuck drills from flat bar steel of the proper size. The practice of using old files for the purpose is not good economy, says a writer in the "Iron Age," unless it be for temporary use. As it is very generally the case that chucked holes are deep in proportion to their diameters, it is very difficult to keep them true, even if started so, unless the body of the drill is straight for the entire length which passes through the drill rest. As the latter holds the drill in position by the diagonally opposite corners, it is obvious that the point or axis cannot remain central as it was set at starting the hole if there be any variation in the width or thickness, or both, of the drill body. Therefore, if old files be used, the only way in which proper tools can be made of them is to forge them straight and of uniform width and thickness from end to end. As this will cost as much or even more than the extra price of new steel, it is poor economy in any case.

Very little work is necessary in making a drill from new material, as it is simply a matter of flattening the end to the desired width and thickness, and cutting off the corners. The widening should, of course, be equally divided each side of the width of the bar, so as to keep the latter central for guiding. The other end should be filed or ground perfectly square, and a good drilled and countersunk centre—not a punched one—made carefully in the centre of the bar section. On all metals except brass the cutting edges should be moderately lipped—that is, the lips should be ground on the corner of the grindstone, and not forged or filed. The forging of the end should not be carried farther back than is absolutely necessary, as it will interfere with setting the drill rest as close to the work as it should be to guide the drill properly at starting. The size of the steel proper to use is that which measures slightly less than the drill size, measuring it across the corners. As the sizes of standard chuck drills vary by sixteenths of an inch, of course two sizes, at least, must be made from one size of steel; but it is not objectionable to make a difference of from 20 to 25 per cent. between size of steel and the largest drill. The best proportions for size of bar are a thickness of one-fourth the width, making 1in. × ¼in., 1¼in. × ⅛in., 1½in. × ⅜in., etc. This will hold good up to quite large sizes—3in. × ¾in., for instance; but beyond this the drill will have sufficient stiffness if the thickness be somewhat reduced.

For large work, particularly in cored holes, it is customary and desirable to fasten lags of hard wood to the drill body and turn them true on the centres, the size of drill. This serves to guide the drill and prevent its following the inequalities of the core. For all pointless chuck drills the temper may be made to range from full hardness to straw colour. For pointed drills the same temper is required as before specified for ordinary drills. In using these tools bad work is sure to result from want of care or knowledge of the proper method of handling them. For castings

having cored holes the drill rest should be set as close to the work as possible, and the drill end placed against the dead centre of the lathe and the point inserted in the rest, but not touching the work. The rest can be roughly adjusted while holding the drill by hand firmly against the centre, and at the same time giving it a forward twist. With the disengaged hand the wrench or hook can be placed on the drill, as close to the rest as possible, and the drill fed toward the work, the lathe having previously been started. Take the cut carefully and slowly, holding the drill very firmly with the wrench, and after it is nearly the full size of the drill, stop feeding and allow it to true up by revolving against the edges until all the spring is out and they do not cut any more. The hole is then started truly central with the work, although the core, of course, is always more or less out of true. The lathe should then be stopped and the accurate adjustment of the rest made by varying the height as required to bring the drill truly central while held firmly in position in the rest. If it be out of centre the hole will be larger than the drill, which, while of no importance except with reference to the last one to be followed by the reamer, is not workmanlike, nor will the drill work as it was designed to do.

The first drill in a cored or existing rough hole should always be firmly held during the whole time it is cutting, or it will run out of true so badly by the time it is through that it may not leave stock enough for those that follow it to clean up. The same precaution is necessary when blow holes, hard spots, or other inequalities in the metal exist. If the hole be true a very light pressure on the wrench, or even holding the drill by the hand, is sufficient to guide it properly. One precaution is always necessary, however, which is to hold the drill firmly against the centre when it is nearly through the hole, as otherwise it is almost sure to drop off as soon as the resistance of the cut is removed, and the result is almost sure to be that the body of drill will catch and cause trouble, and possibly damage, before the lathe can be stopped. In withdrawing the drills it is always much safer to stop the lathe, though it is a very common practice to omit this precaution.

For starting a hole in the solid, with the pointed drill, much subsequent trouble will be avoided if care be taken to have it truly central, and this cannot be accomplished in a hurry. A very good method is to adjust the rest roughly, and holding the drill by hand, without the wrench, feed it in for a short distance—barely enough to have the point fairly entered. Of course it will run out, more or less, but by gradually raising or lowering the rest, or feeding it in or out, as the case may be, it will soon true up. This can easily be known by the entire cessation of the wobbling motion of the drill. During the rest adjustment the drill must be fed in as fast as necessary to cause both edges to cut uniformly and the hole to be the full shape of the drill point. If this precaution be taken, and the drill body bears equally on both top and bottom faces of the rest, there will seldom be any difficulty in keeping the hole approximately true, no matter how deep it may be, unless there are blowholes or some other inequality in the metal to throw it out. This presupposes the use of a drill having the shank fairly straight, otherwise the variations will surely cause it to run out of true unless the rest be constantly adjusted to meet them.

Ordinarily, on medium-sized work, the starting drill should be from $\frac{5}{8}$in. to $\frac{3}{4}$in., and subsequent ones to cut about $\frac{1}{8}$in. on a side, increasing the diameter $\frac{1}{4}$in. each time, until the required size is reached. There is nothing gained by using a less number of drills, and thereby increasing the cut, unless the assortment of drills is insufficient and the job does not warrant their being made specially, in which case the work may be done with such as are available. The use of twist drills for chucking is very common practice, both by placing the centre in shank on the lathe centre and holding the drill by a carrier and bar; and also by the use of a socket in dead spindle. In either case it is necessary to use the utmost care to start the hole perfectly true, otherwise the error will rapidly increase as the drill penetrates, and finally will become so exaggerated as to bind and cause heating and breakage of the drill. In starting, as the drill rest is not available for any but flat drills, a very good plan is to run the heel of a tool held in the tool rest against the side of the drill close to the work, and hold it in such a position as to prevent wobbling. The use of a rigid bar with carrier to keep the drill from turning is very risky, as in case the drill should catch there is great danger of breaking it on the lathe centre, or of doing some other serious damage. The best plan is to use a stick of wood strong enough to hold all the necessary strain of cut, but which will break in case of a catch of any kind. As in case of the flat drills, it is important to hold the drill firmly against centre when the point is going through, as it is even more likely to catch on account of the twist and angularity of the lips to cutting edges.

Fuel Economy in Boiler Firing.*

WITH the variety of fuels on the market the problem how to most economically fire a boiler is a perplexing one, varying for every locality. The owner of the sawmill finds his fuel near at hand in the form of slabs and sawdust, and like many others is relieved of the necessity of choosing. But to the average steam user who has hard and soft coal alike offered him by dealers, and equal transportation facilities, the question which kind of fuel, hard or soft, or if hard which size will give him the best economy, is an important one. Soft coal will give the greatest evaporation per pound of fuel, but it is very possible that a cheaper coal, though more of it may be used, may be more economical.

Or further, it may be found possible to so alter the conditions of burning by use of forced draught, thin fires, etc., that the cheaper coal may be really the cheaper. Of course the proper way for every steam user to deal with the matter is to make his own evaporation tests. This, however, involves expert work or knowledge and the use of apparatus not available to everyone. The next best thing is to get the evidence of someone who has tested the fuels at various prices and in various ways. Then, though the prices for fuel under which the tests were made may differ from those in the vicinity of the reader, still, having a scale of the relative evaporative efficiencies of the different fuels, it is easy for him to determine which is the most economical for him to use.

Among the conditions governing economical running of a boiler plant there is probably no one more important, no one in which there is more variation in practice, than the management of the draught. Ordinary attendance implies keeping the boiler clean inside, preserving an even water level while steaming, clean bright fires, etc. But in the kind of draught and its management lie the fine points of boiler firing, in getting a draught that will supply the greatest amount of air to the fuel, yet will not carry too much heat up the chimney.

The complaint commonly urged against forced draught is that it allows too much heat to escape up the stack. If the damper is wide open that is the case. However, in order to get the advantages claimed for forced draught—namely, high power, quick fuel consumption, and a hot fire,—it is not necessary to run with wide-open damper. Forced draught can be so used as to give a greater output of power without evaporating less water per pound of coal than with the use of the natural draught. Of course there will be more fuel burned, as more power is developed. The philosophy of keeping the damper down as far as possible is that thereby the fire spaces become packed with burning so highly-heated gases, which go off at a high velocity, instead of as a comparatively lazy current through a wide opening, as in the case of natural draught. In general there should not be such an excess of pressure as to inconveniently drive out the ashes around the ashpit doors.

With a 156H.P. Babcock and Wilcox boiler, two tests of soft coal gave 8·70lb. of water evaporated per hour at 212° F. per pound of coal. Three tests of pea coal gave 7·87lb. per pound of coal, forced draught. Four tests buckwheat coal gave 7·86lb. per pound of coal, forced draught. Two tests washed culm gave 7·46lb. per pound of coal forced draught.

Hence it follows that for an equal economy (providing the fuels do not have more refuse than the amounts to be given further on) in any district, pea and buckwheat must not cost more than five per cent. more than washed culm, and soft coal not more than 16 per cent. more than culm or 11 per cent. more than pea or buckwheat.

The average per cent. of refuse for the soft coal was seven per cent.; for culm, 18 per cent.; for buckwheat, 18 per cent.; for pea, 15 per cent. With so large a percentage as in these last, the question of getting rid of the ashes becomes serious, and the extra expense of handling should, of course, be taken into account when the contest between hard and soft coal is close.

THE Turkish Government have completed an armour-clad line-of-battle ship. She is the first vessel of the kind built in a Turkish shipyard.

* By Bertram Flint, in "Mechanical News."

Rose Reamers.

ROSE REAMERS are improperly so called, as their function is purely that of a drill. They should always be made with an odd number of grooves and a corresponding number of cutting edges, so that each of the latter shall come opposite a groove. Usually there are from five to seven, although on very large sizes it is better to have a larger number to avoid the extreme width that would otherwise be necessary. The principal use of the tool—at least, that for which it is most valuable—is for drilling out cored or other existing holes, which are not accurately centred for the required position. They are generally used in the drill press, though sometimes in the lathe and horizontal drilling machine. The shank is best made to fit the standard taper socket, as the tool requires to run perfectly true. The body should be very slightly tapered from point to shank to afford a shade of clearance—that is, the cutting end should be sufficiently larger than the body to prevent the latter from binding as it penetrates, but not sufficiently to cause it to lose its value as a guide, nor to decrease the size of hole as the tool becomes shortened from repeated grinding. The grooves should be made with the right-hand side radial, as it forms the face for cutting edge. It should be well filleted at the bottom, and curved on the left-hand side. Preferably, the work should be done on the milling machine, though, if more convenient, the shaper or planer will answer. The standard grooving cutters made by Brown and Sharpe and others will give the correct form of groove, provided they are set to give the radial face. The shape of the cutting edges, as to clearance on bottom, should be similar to that of other drills; and the side clearance, if any, must be very slight, and not approach too near the leading edge, which would impair the guiding action by decreasing the surface of the cylindrical portion of body. If properly made in other respects, side clearance is not essential, and had best be omitted entirely.

Where cylindrical grinding facilities are available, it is best to finish up the body of the tool a little above size, finish cutting edge clearance, and harden; then grind to exact size, finishing with a fine wheel. For all except small sizes the tool may be used full hardness, or, if drawn at all, only to a light straw colour. Of course this will be too hard for small diameters, as there would be danger of breakage, and they should, therefore, be tempered accordingly—say dark straw colour or brown. Care should be taken to have the entire length of the body of uniform hardness, and not allow the upper portion to be soft, otherwise it will surely cut the first time it is used to that depth. According to a writer in the "Iron Age," the cutting edges should always be sharpened by grinding on an index grinder. If there be no regular machine of the kind available, there should be one improvised, as it is very difficult to grind the edges alike by hand; and unless they are properly done the cutting will necessarily all be done by the leading edges while the others are idle, and the efficiency of the tool be correspondingly impaired. In using the rose drill on rough holes the best method is to insert a centre of wood or sheet iron and scribe with the dividers a circle of the exact size of drill. Then, with a good sharp chisel, chip to the line, keeping the angle of cut uniform and as nearly as possible that of the drill edges. This will generally start the hole true, as laid out, and there is very little danger of its forcing if once the guiding action of the body of drill is brought into effect, no matter how much one-sided the cut may be, provided, of course, that it does not run out altogether, in which case the hole will not clean up, and a larger size must be substituted if the work will admit of it.

Employment in the Engineering Trades.

THE returns for the past month issued by the trade union organisations connected with the engineering industries show a very considerable increase in the number of unemployed members on the books. In the Amalgamated Society of Engineers the out-of-work members in receipt of donation benefit have risen to fully 7½ per cent. of the total membership, whilst the returns of the Steam Engine Makers' Society, which have for a considerable time past been exceptionally satisfactory as regards unemployed, have during the past month risen from about 2 per cent. up to 5 per cent. of the total membership in receipt of donation benefit. To a very considerable extent the increase of out-of-work members is in the shipbuilding centres, where steadily slackening activity continues to be reported generally; but in the immediate district of Manchester there is also a larger proportion of unemployed than in other important inland engineering centres. The number of out-of-work members connected with the Amalgamated Society of Engineers in the Manchester district is considerably in excess of the average for the country generally, and recently a large number of men have been temporarily thrown out of employment by rearrangements which are going on in connection with one or two important engineering establishments in the district; whilst other local causes have further contributed to throw an exceptional number of members upon the books.

Trade Notes.

Messrs. Alexander Stephen and Sons, Linthouse, have received an order to build two steamships of 3000 tons each.

A prominent engineering firm on the Tyne have received orders for four sets of triple-expansion marine engines.

The Yorkshire Engine Company, near Sheffield, in order to be in a position to make first-class boilers, are putting down modern plant.

Messrs. Hingley and Sons, of Dudley, Staffordshire, have contracted with the Italian Government for a quantity of chains and anchors.

Messrs. Dunsmuir and Jackson, engineers, of Glasgow, have received a contract for a steamer of about 400ft. in length for a Spanish firm.

Messrs. A. Colano and Co., of Bussolero, Italy, have received an order for 80 tons of galvanised iron wire for the Telegraph Department at Florence.

Messrs. James Spencer and Co., of Hollinwood, have received an order from the Whitehead Torpedo Factory, Weymouth, for fifteen lathes of different sizes.

The contract for the supply of arc light cables for the Glasgow Corporation has been placed with Messrs. W. T. Henley's Telegraph Works Company Limited, London.

The Haslam Engineering Company Limited, Derby, have purchased from the trustees of Messrs. Pontifex and Wood, the goodwill, plant, etc., of the business.

Messrs. A. and Z Daw, of London, have contracted with the Oscar Mining Company, [illegible] to supply a complete plant of rock drills and an air-compressing engine.

Messrs. J. Oates and Co. Limited, of Alfreton Ironworks, Alfreton, have obtained the contract for the supply of a quantity of 30in. cast-iron pipes required by the Burton-on-Trent Corporation.

The Stanton Ironworks Company, of Stanton, near Nottingham, have secured the contract for the supply of cast-iron pipes, etc., required for the new waterworks belonging to the Uttoxeter Rural Sanitary Authority.

The extensive works of the Birmingham Small Arms and Metal Company, and the Royal Gun Factory, at Sparkbrook, near Birmingham, are extremely busy on Government orders. The company are producing 5000 6-pounder shells per week, and have orders that will last several months.

Messrs. Gwynne, of Hammersmith, London, are constructing the largest centrifugal pumping engines yet attempted. The suction main is 58in. in diameter, and at normal speed each pump will throw 400 tons of water per minute. The engines are to replace the famous machines at Haarlem Meer, Holland.

At the thirteenth annual meeting of the Ashburys Railway Carriage and Iron Company Limited, held on the 24th inst., a dividend of 2½ per cent. was declared, which with the interim dividend of 2½ per cent. paid on the 19th April last makes 5 per cent. for the year.

Messrs. Bolckow, Vaughan and Co., Middlesbrough, are so well satisfied with the results obtained from the mixer which was erected some weeks ago at their Eston steelworks, that they have decided to erect two others, each of the same design as the first, and of the same capacity—viz., to hold 120 tons.

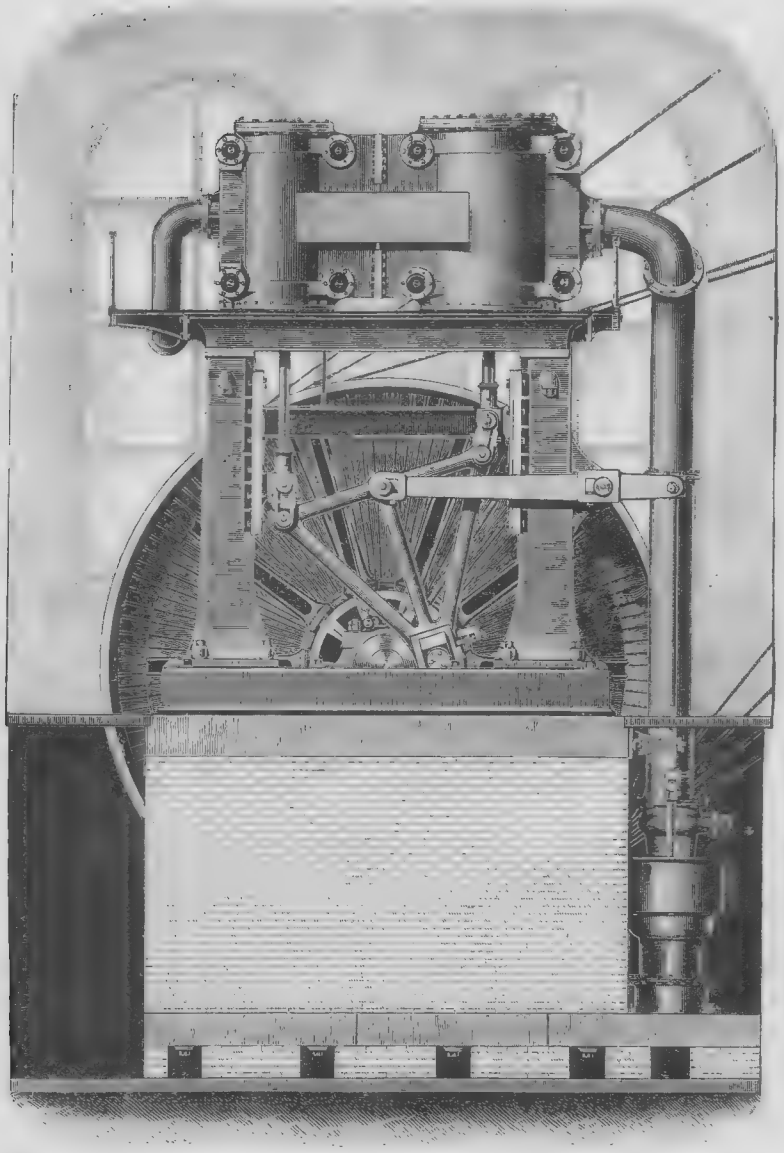
Readers of "The Mechanical World" are invited to send to the publisher of "Good Health," the new weekly paper devoted to food, drink, medicine, and sanitation, for a parcel of specimen copies, which will be sent gratis and post free, for distribution among their friends at home and abroad. Address, 391, Strand, London, or New Bridge-street, Manchester.

Wheel cutter in metal only. Every description of gearing. R. CHILDLAW, 43, City-road, Manchester.

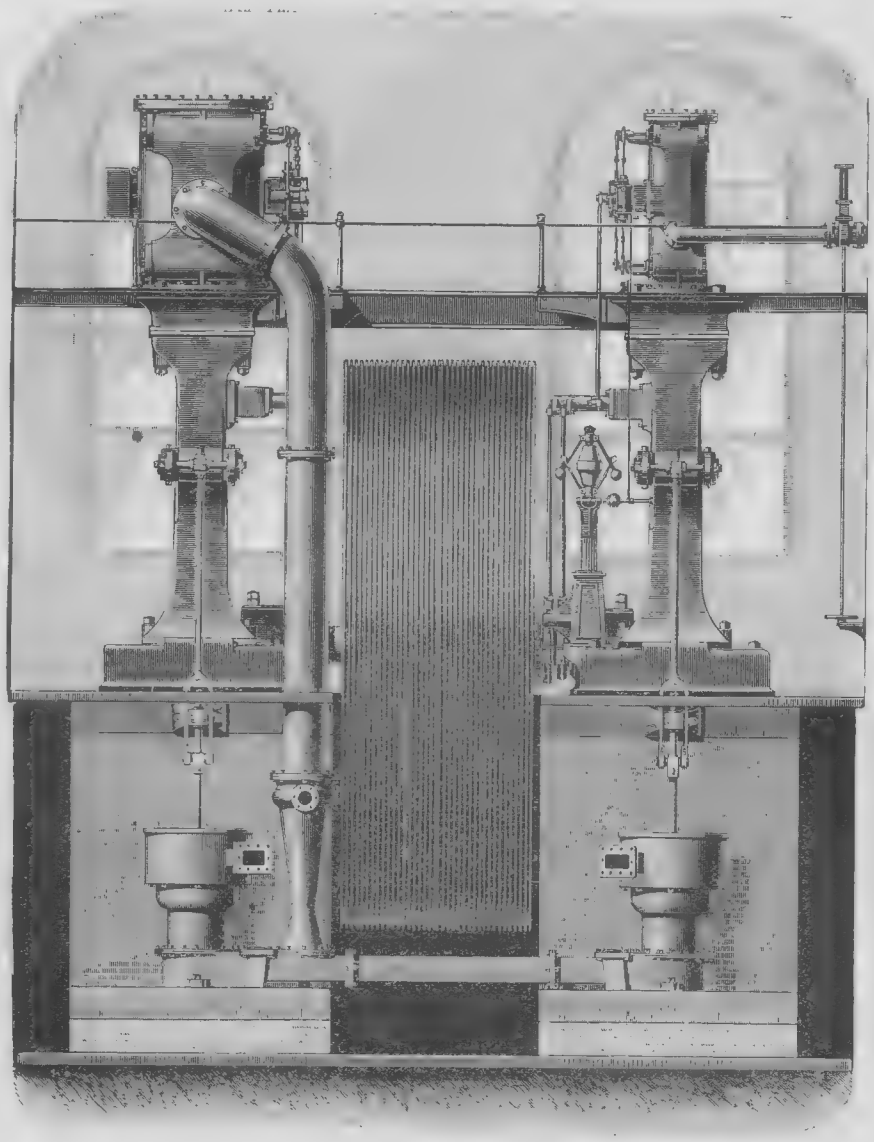
Having regard to the enormous circulation of THE MECHANICAL WORLD, the Editor suggests that it is by far the best medium for the insertion of every kind of "Wanted" advertisement, and the price is only one halfpenny per word. The Editor will be glad if MECHANICAL WORLD readers will kindly bear this in mind as occasion arises.

1600 I.H.P. QUADRUPLE-EXPANSION ENGINES.

MESSRS. JOHN MUSGRAVE AND SONS LIMITED, ENGINEERS, GLOBE IRONWORKS, BOLTON.



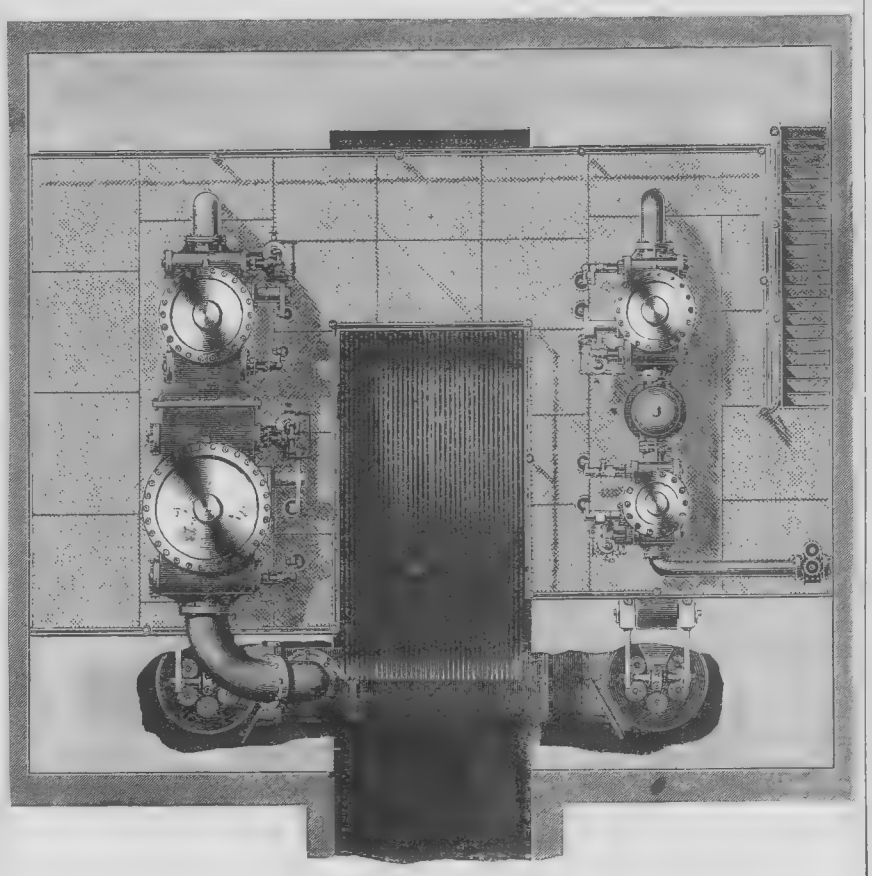
End Elevation.



Side Elevation.

Quadruple-expansion Mill Engines.

Concomitantly with the development of the rational theory of the steam engine it has become increasingly evident that to obtain the most economical results high steam pressures and a correspondingly large number of expansions must be employed, and as a consequence the triple-expansion engine is being largely adopted wherever economy of fuel is of the first importance. In the marine service this requirement is, of course, a *sine quâ non*, and it is therefore not surprising that the most economical engines are of the marine type. On the other hand, it is somewhat difficult to understand why the example set by the marine engineer was not earlier emulated by our high-class stationary-engine builders. Considering that triple-expansion marine engines have now been in use for nearly two decades, it certainly appears not a little remarkable that only within the last three or four years has the principle been extended to stationary-engine practice. For cotton-mill driving, however, the triple-expansion engine has already proved eminently suitable, and it may now be considered as the recognised type of engine for a service calling for the highest economy of fuel and close regulation of speed. The development of the multi-cylinder engine has been largely due to the recognition of the fact that to obtain the best results the working steam should only be permitted to expand a limited number of times in each cylinder, and consequently to obtain the best results from steam of a higher pressure than usually adopted in the triple-expansion engine, it is clearly necessary to increase the number of cylinders through which the steam is successively passed. Quite a number of four-cylinder quadruple-expansion marine engines have been employed for some years, and it is now our pleasing duty to chronicle the application of the type to mill driving, as exemplified in the fine set of engines shown in the accompanying illustrations, which have been built by Messrs. John Musgrave and Sons Limited, of Bolton, for the No. 2 mill of the Peel Spinning and Manufacturing Company Limited, Bury. These engines, while generally representing the most recent advance in the economical development of power, also possess several points of interest which in our opinion peculiarly adapt them to their particular purpose. As will be seen, two sets of vertical inverted-cylinder engines are employed, with the rope-driving drum between them, the high-pressure and first intermediate cylinder constituting one pair, and the second intermediate and low-pressure cylinder the other pair. From the end view of the engines it will be observed that a triangular connecting rod is employed to transmit the efforts from the crossheads to the crankpin, each of the upper angles of the triangular rod being connected by means of links to the two crossheads as shown. As each pair of engines are similar, and the two cranks are placed 180° apart, the weights of the two sets of reciprocating parts mutually balance each other, thereby conducing to smooth running even at high speeds. We may here state that this arrangement has been patented by Messrs. Fleming and Ferguson, of Paisley, who have made several sets of marine engines on this principle.



Plan.

Although the two crossheads of each pair of cylinders are in this way connected to one crank, the action of the triangular connecting rod is such that no dead centre exists in either engine, as the pistons never reach the end of their respective strokes at the same time. In point of fact, the resultant turning effort upon the crank is similar to that which would be obtained from a pair of cranks set nearly at right angles to each other, for when one piston is at the end of its stroke the other is nearly in its central position, and in consequence has a very effective leverage to turn the crank. Upon reflection, it will be evident that as a consequence of this action the efforts on the crank are gradually changed in direction *around* the crankpin from one side to the other, no sudden reversal of stress occurring as in the ordinary arrangement; this, again, is a feature of great importance, inasmuch as it still further facilitates the use of high speeds. Another advantage accruing from the use of the triangular connecting rod is the diminution of friction owing to the pressure upon the guides being much less than with an ordinary engine having a connecting rod of usual proportions. This effect is a consequence of the method of controlling the motion of the connecting rod by coupling it at the centre of its upper member to a pair of horizontal vibrating levers, which turn upon a pin fixed in the engine framing, as shown above, and a prolongation of which serves to actuate the air pumps. As will be seen, the motion of the ends of the triangular connecting rod to which the crossheads are connected, is compounded of that due to the movement of the vibrating lever and circular motion of the crankpin, and the resultant effect is such that these ends of the rod move in

nearly vertical lines, and therefore greatly reduce the lateral pressure on the guides. This is, in our opinion, a very important advantage, since all the benefits of an abnormally long connecting rod are obtained, with an actual length not greatly in excess of the stroke of the pistons, thus considerably reducing the head room required, while bringing the weight of the structure much lower than would otherwise be possible. The general result is a remarkably compact engine, all parts of which are easily accessible, and occupying about one-third the floor space (the engine-room is only 32ft. long by 38ft. wide) required for a horizontal engine of equal power. From the upper platform all the valve gearing is easy of access; while the steam stop valve may be operated from the platform or from below as desired. Substantial bed-plates are arranged on each side of the wheel-pit, upon which the framing is erected, supporting the cylinders above. The engine has cylinders 18in., 26in., 37in., and 54in. in diameter respectively, with a stroke of 4ft. 6in., and running at 80 revolutions per minute, and with a steam pressure of 200lb. per square inch it will develop 1600I.H.P. Corliss valves are provided throughout, the admission valves for the high-pressure and first intermediate cylinders being under the control of the governor, by which means the cut-off may be varied from 0 to ⅔ stroke; the cut-off in the other cylinders is adjustable by hand. All the admission valves are provided with Musgrave's patent trip gear. The crankshaft is 16½in. in diameter, swelled to 19in. at the centre; the shaft necks are 15in. in diameter, and 30in. in length; while the crankpins are 9in. in diameter and 10½in. long. The rope drum, which is grooved for 36 1⅝in. ropes, is 21ft. in diameter, giving a rope speed of 5280ft. per minute, at which speed each rope is capable of transmitting 46·5H.P. For some of the secondary driving a still higher rope speed is employed—5654ft. per minute. The distance from the centre of the shaft in the upper floor of the mill to the centre of the rope drum is 82ft., and the distance from the lower main shaft to the centre of the drum, 37ft., both good ordinary working lengths. The engines are complete in every respect, and special means have been provided to ensure the constant and efficient lubrication of the bearings. Musgrave's patent safety-barring engine is fitted to the main engine for the purpose of readily clearing the cylinders of water, or for turning the engines while adjustments or alterations are being made. The engine room is provided with a powerful overhead travelling crane, and is well lit by large windows during the day, and is provided with electric lights for illumination at night.

The very fine mill building has been erected from the plans and under the superintendence of Mr. Joseph Stott, architect, 26, Clegg-street, Oldham. It is a five-storey fireproof building, 336ft. long and 134ft. wide, planned on the best modern lines and most compactly arranged. Accommodation is provided for over 100,000 spindles. The long front elevation is relieved by two staircases, the extra one being provided as an additional outlet in case of fire. Over the main staircase is a tower for the cistern supplying the sprinkler service. The floors are formed of brick arches carried on steel joists. The engine house is at the back of the mill, and is faced internally with glazed bricks, with dark-brown dado and cream-coloured walls, the ceiling being finished in varnished pitch-pine. In the boiler house accommodation is provided for five steel Lancashire boilers by Messrs. Edward Heaton and Son, Manchester, completely equipped with all necessary fittings. Messrs. Green and Sons Limited, of Manchester and Wakefield, have supplied one of their latest improved fuel economisers, containing 480 pipes and specially adapted for the high pressure employed. As the boiler house is contiguous to the company's railway siding, arrangements have been made by which the coal can be conveyed by machinery direct from the railway trucks to the boiler fires. Adjacent to the boiler house is the dynamo house containing the engines and dynamos. The premises are fitted up with every convenience for efficient and economical working, and are provided with electric light throughout.

We may add, in conclusion, that we had the pleasure of being present at the formal starting of the engines, which took place on Saturday last, in the presence of a large and distinguished company of engineers, millowners, and others interested in this new and important departure. In the evening the company dined at the Derby Hotel, when speeches were made by Mr. Warburton, Mr. Walter Musgrave, Mr. Joseph Stott, the Mayor of Bury and others.

Economics of "Automatic" Engines.

By Prof. R. H. Thurston.

The "automatic" steam engine is a form which, though a generation old, has come into very general use only within a few years, and mainly since the demands of electric lighting have been so exacting in the matter of regulation. In earlier days, a variation in speed of 5 per cent. or more from the mean, in many applications of steam power, was perfectly admissible; and even in the most exigent of work, that of cotton mills making "fine goods," 2 per cent. variation was thought about the limit of practical attainment, and very satisfactory. It is now considered that a range of 1 per cent. from the mean is too great for the purposes of the electrician, and, so far has invention and improvement extended, it is possible to secure a guarantee, from makers of the later forms of the "automatic" engine, that no variation shall take place though the load be thrown off entirely and at once completely restored; while, with some constructions, it is actually practicable to make the machine assume a higher speed with full load than with none. This is an incidental result of the attempt to meet the requirements of modern engineering; which requirements compel a complete revolution in the type of engine formerly most familiar to us.

The greater part of the machinery to be driven by these engines, as constructed by the electrician and engineer, calls for a small amount of power and a very high speed of rotation. The armatures of standard forms of dynamo-electric machines ordinarily range from speeds of 1000 to 3000 revolutions per minute, though special constructions are brought down to a fraction of these figures. The power is from 10 to 40 or 50H.P. in common distributions, and up to as high as 250 for the largest single dynamos; although, often, the dynamos may be so grouped that from 500 to 1500H.P. may be taken from one engine. It is not yet possible, in all cases, to determine whether a large single engine or several smaller machines of similar aggregate power is best; but the demand for the small engine of from 25H.P. to 100H.P. is enormously great, and the manufacture of this class of engine has been immensely stimulated by the comparatively recent developments of systems of production and of distribution of electric energy. These machines are commonly of the class here denominated "automatic," are "high-speed" engines of a modern and special type, and are characterised by a "positive" valve gear, as distinguished from the older and more familiar forms of "trip cut-off" or detachable gear, with regulation by a governor which determines the point of cut-off by, usually, shifting an eccentric, as years ago employed by Hartnell and by Hoadley, and this engine is built to operate at a speed seldom less than 200 revolutions a minute, and often above 300. The positive motion, as a valve system, and the shaft governor, are necessary consequences of the demand for high speed of rotation and nice regulation; the latter being, in fact, a more essential matter than the former, and one which has compelled many modifications of the details of construction of the older forms of engine to secure satisfactory uniformity of motion. The characteristics and the essentials of each type are now so familiar to all that it is unnecessary for present purposes to describe them in detail. An "automatic" engine has come to be defined as one in which these methods of construction have been adopted, and which, having a positive valve motion and firmly connected governor, adjusts its power to its load automatically through the latter. The definition logically applies quite as well to the Corliss and Greene and similar detachable systems of valve gear; but convention seems to confine it to the later high-speed engine.

The modern automatic engine, at its high speed of rotation, brings into play the forces of inertia to an extent never observed in the older machine, and its design must

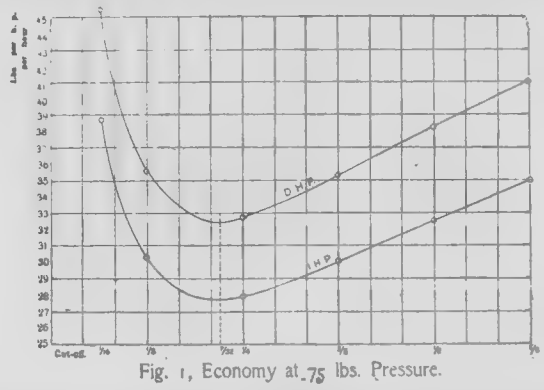


Fig. 1, Economy at 75 lbs. Pressure.

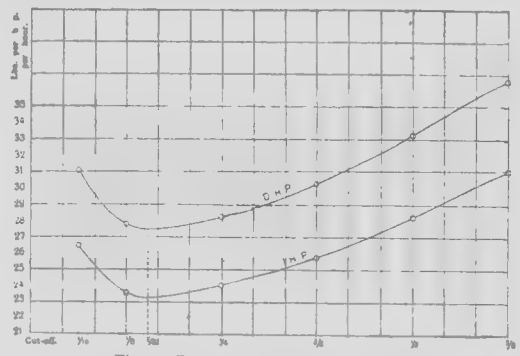


Fig. 4, Economy at 135 lbs. Pressure.

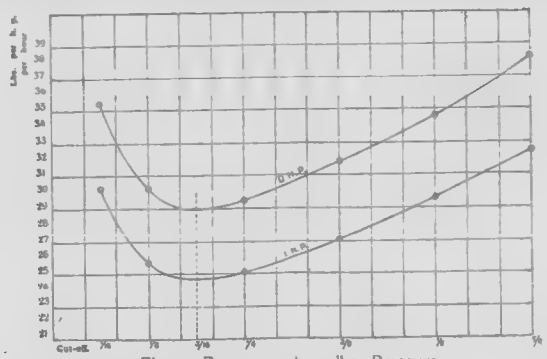


Fig. 2, Economy at 95 lbs. Pressure.

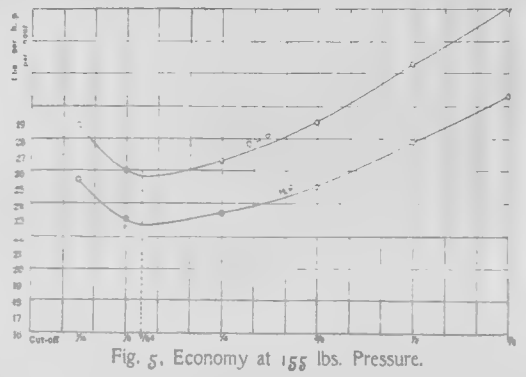


Fig. 5, Economy at 155 lbs. Pressure.

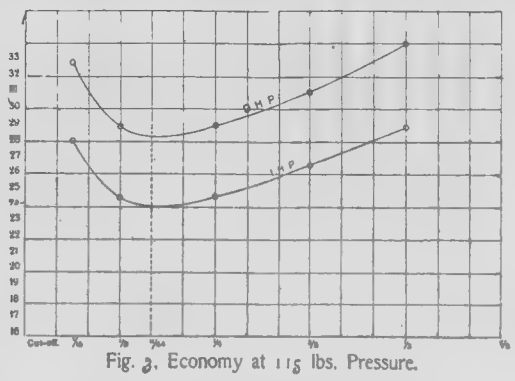


Fig. 3, Economy at 115 lbs. Pressure.

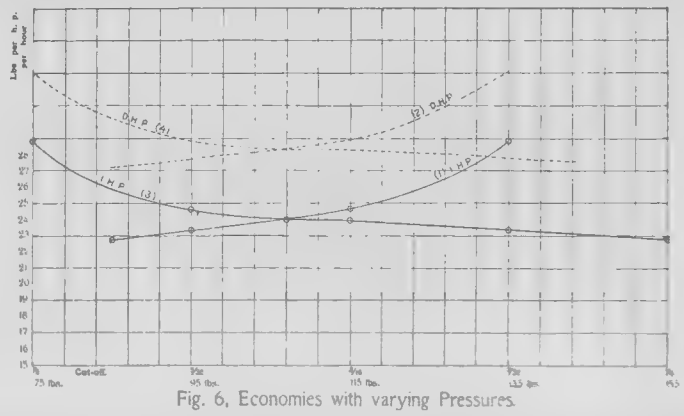


Fig. 6, Economies with varying Pressures.

The following is an illustration of these facts, as determined for an "automatic" simple condensing engine, rated at 10 to 15H.P.; having a cylinder 6in. in diameter and 8in. stroke of piston, its speed 280 revolutions a minute, and the machine proportioned for a steam pressure of 100lb., though strong enough to be driven, if necessary, with a much higher, perhaps, with little risk, at 50 per cent. higher pressure. Compression is complete and leakage insensible.

It is proposed to compute the demand for heat and steam for the purposes of designer and purchaser, on the assumption of the data given below, the conditions as to waste being substantially those illustrated in the Sandy Hook experiments of 1884. Pressures are taken from 75lb. to 155lb. per sq. in. above the atmosphere; ratios of expansion from 1·6 to 16, and the engine as speeded at 280. External wastes of heat are assumed to average 0·5 B.T.U. per sq. ft. of external surface and per degree range of temperature from atmospheric—here taken as 100° F. Internal wastes are taken as aggregating as a fraction of the total steam supplied, $w = a/d.\sqrt{r\,n}$, where the coefficient $a = 4$ in the case assumed to be fairly representative

ments have been the subject of many and extended investigations, both mathematical and experimental, and the result has been admirable success in the improvement of the standard engine of the time in this respect, and beautifully smooth running, where intelligence and experience have conspired in design and construction. It is proposed to consider the economics of such an engine, assuming it to represent the best contemporary practice in these respects, and to be ready for operation under at least ordinary favour-

able conditions. The exact expenditure of heat, steam, and fuel under specified representative conditions of this case, including steam pressure, back pressure, ratio of expansion, and boiler efficiencies, can be computed for the thermo-dynamic, ideal case; and, knowing the magnitude and conditions of physical operation of the engine, friction included, its wastes of energy, whether thermal or dynamic, can be very closely obtained by computation, and these wastes being added to the total thermo-dynamic expenditure, the gross outlay of energy becomes known and the economical problem can be solved.

of that here considered; d is the diameter of cylinder in inches, r the ratio of expansion, and n the number of revolutions per second. This simple expression will probably answer present purposes, in the absence of a more exact and better-established one. Friction wastes are taken as found for short cut-offs, efficiency of the engine as a machine being assumed at 0·85. Better work than this can be and should be done. J is taken as 778. The following are the assumed data:—

$$\begin{array}{llllll} p_1 = 75 & 95 & 115 & 135 & 155 \\ p_3 = 5 & 5 & 5 & 5 & 5 \\ r = 1{\cdot}6 & 2 & 4 & 8 & 16 \end{array}$$

$$c = \frac{1}{r} = \frac{5}{8} \quad \frac{1}{2} \quad \frac{1}{4} \quad \frac{1}{8} \quad \frac{1}{16}$$

Pressures are here measured from absolute zero.

The work per cubic foot of steam is here computed by the familiar expressions of Rankine:—

$$UD_1 = JD_1\left[T_1 - T_2\left(I - \log_e \frac{T_1}{T}\right)\right] - \frac{T_1 - T_2}{T_1} l_1 - r(p_2 - p_3).$$

and

$$p_2 = UD_1/r.*$$

The results of these computations as made and checked by Messrs. C. B. Auel, A. R. Henry and F. P. Ide, following the methods prescribed by the writer, are presented in the accompanying table:—

steam in a similar manner; the numerical values of the former quantities increasing, and the latter decreasing with rising steam pressure. The weight of steam consumed is not far, at best, from

$$w \quad 250 / \sqrt{p}$$

pounds of steam per hour per I.H.P., when working under best conditions; and the best ratio of expansion, on the same basis, is about

$$r = 0{\cdot}5\sqrt{p}$$

The conditions here assumed may be taken as fairly representative of good practice with such an engine. Where leakage occurs, or when compression is incomplete and the clearances thus become sources of additional wastes, these figures may be much exceeded. Experiments with an engine of such dimensions and proportions as are here assumed, as made under the eye of the writer, have given internal wastes through these faults of construction and of operation, amounting to three times that here found, and bring the expenditures of steam and fuel up to much higher figures. Those here obtained, however, correspond with working conditions which can probably always, with care, be obtained in the actual case, and may serve as a guide in the designing or the selection of such engines for use. Larger engines will be less subject to such wastes, and the margin between the ideal case and the actual may be thus reduced approximately in proportion to increasing size of engine. The economically desirable ratio of expansion and point of cut-off, however, is always somewhat less than that found to give lowest expenditure of steam and fuel, since every item of cost in the construction of the engine involves a corresponding annual charge thereafter, and a compromise between increasing annual expense on this count, and decreasing cost of fuel, must be made to secure the best results.

r	Cut-off.	Pressure, lb. per sq. in.	Temperature Absolute. T_1.	Density of Steam.	Latent Heat, Foot-pounds.	Terminal Pressure, lb. per sq. in.	Terminal Pressure, lb. per sq. ft.	Temperature. T_2.	Indicated Power.	Steam per I.H.P. per Hour (Ideal) W.	Internal Waste Coeffic. $\frac{a}{d}\sqrt{\frac{r}{n}}$	Internal Waste, Pounds per I.H.P. and per Hour.	External Waste, Pounds per I.H.P. and per Hour.	Total Waste, Pounds per I.H.P. and per Hour.	Total Consumption, Pounds per I.H.P. and per Hour.	Same per D.H.P.
16	1/16	75	763·6	0·175622	110,437	3·22	463·7	605·4	3·100	15·85	1·234	19·56	3·30	22·86	38·71	45 51
8	1/8	75	768·6	0·175622	110,437	7·08	1,020	638·6	6·42	15·32	0·87287	13·37	1·50	14·93	30·25	[illegible]
4	1/4	75	768·6	0·175622	110,437	15·55	2,239	676	11·77	16·72	0·61720	10·32	0·847	11·167	27·887	[illegible]
2·7	3/8	75	768·6	0·175622	110,437	24·29	3,498	699·7	14·97	18·48	0·50710	9·88	0·666	10·546	30·026	35·32
2	1/2	75	768·6	0·175622	110,437	34·15	4,918	719	17·85	21·44	0·43650	9·71	0·555	10·265	32·51	38·24
1·6	5/8	75	768·6	0·175622	110,437	44·00	6,336	731·2	19·90	24·76	0·3900	9·63	0·502	10·162	34·93	41·08
16	1/16	95	785·1	0 219130	151,336	4·08	588	615	4·83	12·74	1·234	15 73	1·663	17·393	30·133	35·45
8	1/8	95	785·1	0·219130	151,336	8·97	1,292	649·4	9·31	13·21	0·87287	11·53	0·969	12 4 9	[illegible]	[illegible]
4	1/4	95	785·1	0·219130	151,336	19·70	2,837	688·4	15·97	15·42	0·61720	9·09	0·566	9 6 6	[illegible]	[illegible]
2·7	3/8	95	785·1	0·219130	151,336	30·77	4,431	713	20·58	17·72	0·50710	8·99	0·428	9·418	[illegible]	[illegible]
2	1/2	95	785·1	0·219130	151,336	43·26	6,229	733·1	24·20	20·34	0 43650	8·88	0·375	9 255	[illegible]	[illegible]
1·6	5/8	95	785·1	0·219130	151,336	55·72	8,024	749	26 62	23·11	0 3900	9·02	0·333	9·353	[illegible]	[illegible]
16	1/16	115	799·1	0·262732	179,142	4·94	711·8	623	6·18	11·91	1·234	14·70	1·360	16 060	27·97	32·91
8	1/8	115	799·1	0·262732	179,142	10·86	1,564	658·4	11·62	12·68	0·87287	11·07	0·755	11·825	[illegible]	[illegible]
4	1/4	115	799·1	0·262732	179,142	23·84	3,433	698 6	19·68	14·97	0·61720	9·24	0·415	9·655	[illegible]	[illegible]
2·7	3/8	115	799·1	0·262732	179,142	37·25	5,364	724	25·28	17·35	0·50710	8 80	0·331	9 131	[illegible]	[illegible]
2	1/2	115	799·1	0·262732	179,142	52·36	7,540	745	29 64	19·88	0·43650	8·68	0·276	8·956	[illegible]	[illegible]
1·6	5/8	115	799 1	0·262732	179,142	67·46	9,714	761·5	32·60	22·60	0·3900	8·82	0·251	9·071	[illegible]	[illegible]
16	1/16	135	811·2	0·305659	206,286	5·8	835·6	630	7·534	11·38	1·234	14·05	1·043	15·093	26·473	31·14
8	1/8	135	811·2	0 305659	206,286	12·75	1,836	666·2	13·91	12·32	0·87287	10·75	0·504	11·314	[illegible]	[illegible]
4	1/4	135	811·2	0·305659	206,286	27·99	4.031	707·6	23 37	14·67	0·61720	9·05	0 344	9 391	[illegible]	[illegible]
2·7	3/8	135	811 2	0 305659	206,286	43·73	6,297	733·9	30·00	16·96	0·50710	8·60	0·263	[illegible]	[illegible]	[illegible]
2	1/2	135	811·2	0·305659	206,286	61·47	8,852	755 3	35·00	19·54	0·43650	8·53	0·226	8·756	[illegible]	[illegible]
1·6	5/8	135	811·2	0·305659	206,286	79·19	11,403	772·4	38·50	[illegible]	0·3900	8·68	0·208	[illegible]	[illegible]	[illegible]
16	1/16	155	822	0·348265	232,738	6·63	959·4	635·80	8·89	10·98	1·234	13·55	0·836	14·336	25 06	28·84
8	1/8	155	822	0·348265	232,738	14·63	2,106	673	16·20	12·05	0·87287	10·52	0·462	10·982	23·03	27·09
4	1/4	155	822	0·348265	232,738	32·14	4,628	715·3	27·00	14·41	0·61720	8·89	0 274	9 164	23·57	27·73
2 7	3/8	155	822	0·348265	232,738	50·2	7,223	742·3	34·58	16·72	0·50710	8·48	0·213	8·693	25·41	29·89
2	1/2	155	822	0·348265	232,738	70·58	10,163	764·5	40·50	19·28	0·43650	8·41	0·182	8·592	27·87	32·74
1·6	5/8	155	822	0·3 9265	232,738	90·92	13,092	782	44·48	21·95	0·3900	8·57	0·164	8·314	30·68	36·26

An examination of the figures here collected will show in a most interesting manner the gradual variation of steam consumption with change of expansion at each pressure, and a comparison of the figures for the several pressures will illustrate the interesting modifications of results due to variations of expansion with pressures, and the differences in the location of the best points of cut-off for these pressures. These instructive comparisons are best made by the construction of curves, of which the co-ordinates are, for each pressure, weights of steam demanded per horse-power and per hour at stated ratios of expansion. Such curves have been drawn by the computators for the present case, and are illustrated in the accompanying plates. It is seen that at the lowest pressure, 75lb., maximum economy of steam and fuel is attained at a cut-off very near $\frac{7}{32}$, or a ratio of expansion of about 4·5, when the dynamo-metric power is taken, or at about a cut-off of 0·2 and $r=5$, on the basis of indicated power. These figures become about 3·16 and 5 at 95lb., $\frac{11}{64}$ and 6 at 115, $\frac{5}{32}$ and 6·4 at 135, and $\frac{9}{64}$ and 7 when the pressure becomes 155 absolute, or 140lb. by gauge.

This gradual shifting of the ratio of expansion giving highest economy of fuel and of steam is better illustrated in the last set of curves, in which two exhibit the variation of this point of cut-off with varying pressures, while the other pair show the progressive gain in economy of fuel and of steam in a similar manner; ...

The commercially desirable ratio of expansion is always less than that giving maximum duty; but the margin between the two depends greatly upon the relative costs of construction and of operation of engine and boiler and cost of fuel. Methods of exact computation are becoming developed, and approximate methods are well known.† In general, at the commercial centres the ratio to be adopted in designing will not be far from two-thirds that here found to give best effect for the ideal case, 20 per cent. lower than is shown on the diagrams for the actual case, and still lower where it is sought to make the most out of an engine already set and in operation.

The mean effective pressure here found is seen to be not far from

$$p_2 = 6\sqrt{p_1}$$

and the pressure to be adopted by the designer for such cases will be greater, perhaps not far from

$$p_1 = 5\sqrt{p_1} -$$

gauge-pressures being here taken, while the power of the engine is seen to be approximately

$$\text{I.H.P.} = 0{\cdot}03\, d^2 \sqrt{p_1}$$

nearly, and slowly rising with increasing pressure. Had the wastes of the engine been larger, which is oftener the case than the opposite, the cut-off would be deferred, the ratio of expansion lessened, the mean effective pressure increased, and the relative power for a given size of engine increased, since in such cases the gain by reduction of wastes more than offsets the thermodynamic gain by the reverse process of increasing the ratio of expansion. The figures here obtained may be taken as representing the limit of expansion in the case of the best makes of automatic engine, under best conditions of operation. In the usual case, a lower ratio of expansion and larger mean pressure will be desirable — "Journal of the Franklin Institute."

*Rankine's Prime Movers; Thurston's Manual, p. 393.

† Manual of Steam Engines, vol. 1, chapter vii.

The Electric Transmission of Power.

(*Concluded from page* 164.)

THE city of Pueblo possesses an electric lighting plant which is in many ways remarkable. Two hundred arc lamps of 1200C.P. are run by four 50-light arc machines in a station some 13 miles away from the centre of the town. The power is furnished by the river Atoyac, operating a 200H.P. Leffel double turbine. Each of the four existing circuits is about 26 miles in length, and consists of a No. 4 insulated wire. The dam and the masonry of the station itself have been built of fine-cut stones, and form probably one of the most substantial and well-built structures in Mexico.

A contract recently entered into by the Thomson-Houston International Electric Company provides for a plant to be worked by water-power near the town of Pireacicaba, Sao Paulo, Brazil. The system will probably comprise 50 arc lamps of 1200C.P. each, and about 2000 incandescent lamps of the alternating system. In this case the power station will be only about a mile away from the town.

We find that in the celebrated Comstock Mine in Nevada, water from the mountain lake has been turned down one of the shafts of the mine for 1200ft., and at this depth in the earth a series of specially-constructed wheels are located, coupled direct to the dynamo machines. This novel plant is still in successful operation. It consists of six generators, ranging from 100 to 120H.P. capacity each, and six motors of 60H.P. each.

As so much has been said in the papers recently about the Niagara power plant, the forces exerted by this immense volume of water may be of interest.

Some twenty-one million cubic feet of water pass over the head of Niagara every minute.

The idea of the great Niagara tunnel is said to have originated with the late Thomas Evershed. The tunnel or tail race is to extend from the surface of the water level below the Falls to a point on Niagara River above the Falls. It is to be connected with the river by means of short surface canals, wheel pits, and cross channels.

The power expected to be produced by the capacity of the tunnel will be equal to the water-power of Lawrence, Lowell, Holyoke, Turner Falls, Manchester, Bellows Falls, Lewiston, Me., Oswego, Paterson, Augusta, Ga., Minneapolis, Rochester, and Lockport combined.

The method of using the power is to be the same as that in operation upon the hydraulic canal.

The tunnel is to be of a horseshoe section, having a capacity equal to a circle of 25ft. in diameter, extending through the solid rock from the water level below the falls to the river above the cataract, a distance of one mile. From this point the tunnel is to continue parallel to the shore of the river one and a half miles more, at an average depth of 160ft. below the surface, and about 400ft. from the river, with which it will be connected by surface conduits. The tunnel is used as a tail race, and the great length is necessary to avoid marring the scenery. Plans have been made for a 120,000H.P. plant.

Crossing over to Ontario, we find that a scheme is contemplated to utilise the Canadian Falls. The plan is wholly different from that on the American side, and no long tunnel is necessary. Mr. Ferranti has this work in hand.

The papers have discussed a scheme for transmitting power from Niagara to the World's Fair, which involves a distance of 475 miles, or more than four times that separating Lauffen and Frankfort. Eighty thousand volts is the suggested voltage.

California capitalists were among the first to recognise the value of electrical transmission for mining purposes. A power plant was built by the American River Syndicate, of El Dorado County, more than two years ago, which utilised the water-power of Rock Creek. The plant consists of an 8ft. Pelton wheel, running under a head of 110ft. with a 5½in. nozzle. It has a maximum capacity of 130H.P. The current generated is used at the mills, situated some two miles distant, three centrifugal rolling mills and a ten-stamp battery and rock breaker being operated. The potential used is 100 volts, and 75 per cent. of the power generated is available for duty at the mill. The entire works are further lighted by incandescent lamps. The mills are handling an average of 4000lb. of ore per month, and a saving of some 60 per cent. over the former method has been effected.

Other plants are located at Grove Mine, in Amador County, Cal., and at the Cœur d'Alene Company's Works, Idaho.

Probably in the before-mentioned Lauffen-Frankfort installation the highest potential yet attempted on a large scale was utilised. There a voltage up to 30,000 volts was obtained, and the insulators were found able to stand the pressure.

It is figured that if an installation can be made capable of standing 1,000,000 volts, over 30,000H.P. can be transmitted 500 miles with a 0000 wire with a loss of less than one-half per cent. One ampère at this pressure would transmit 1250H.P.

The application of electricity to steam railroad propulsion is a problem that is now upon us. Since the first of this year the engineers of five of our largest railroad systems have been in consultation with the electric companies in reference to this matter.

We have in course of construction a 32-ton locomotive that can easily run 70 miles an hour, and before the end of the year the power and speed of the electric locomotive will be a demonstrated fact and no longer a theory. It will be easy to demonstrate its economy in many places where it can advantageously replace the steam locomotive; but for long-distance runs it cannot at present compete with steam except under unusually favourable conditions; as for example, where there are a succession of water-powers that can be utilised as sources of energy. At present we can only speak of what is to be done. Next year I trust we can point to what has been done.

The application of electric power to street car propulsion comes nearer to the masses, and is of more direct benefit to mankind than any other application at the present time. It is almost universally acknowledged that the vexed question of "rapid transit" can only be solved by the use of the electric motor. The development in this respect has been enormous.

There are in the United States, according

to the census of 1890, sixteen cities of over 200,000 population. There are electric railways in fourteen of these, or in over 87 per cent. There are forty-two cities of from 50,000 to 200,000 population, and of these forty-one, or over 97½ per cent., are supplied with electric railways. There are 450 electric railways in the United States at the present time, and over 6400 cars operated by electric power, and sixty-two more roads are being constructed.

Notwithstanding the constant newspaper statements as to the dangers of the trolley system, we have yet to find a single authenticated instance of death caused by the 500-volt railway current carried in the trolley wires. We have at our office many newspaper clippings alleging such cases; but upon investigation every one is found to be incorrect, the death, where there is any fatal result, arising from other causes. For example, a workman in Bangor, Me., was painting a building, and short-circuited an alternating incandescent current through his body, falling from the building, and being picked up dead. According to the newspapers his death was caused by the trolley, though, as a matter of fact, he was never near the trolley wire—never came in contact with it. These facts were certified to by the coroner. I was told of a man who fell from a building 40ft. to the ground. He struck the trolley wire in such a way as to produce a short circuit, which slightly burnt his leg. He stated that the trolley wire in all probability saved his life, as it broke his fall.

On the 16th of this month, the Cambridge line of the West End Company in Boston had just been in operation three years. Since February 16, 1889, there have been many additions made to the electrical equipment of the West End Road. Until now they have 120 miles equipped electrically, and over 300 electric cars in operation.

Last year 119,264,401 passengers were carried on these West End cars, and not one single individual has ever been killed or seriously injured by the trolley current. There have been accidents — very sad accidents. Men, women, and children have been run over and killed; but such accidents happen on every road, whatever the motive power, and it is a striking and most significant fact that the insurance companies which insure street railways against loss by accidents find relatively more accidents on horse-car lines than on cable roads, and more accidents on cable roads than on electric roads.

Metal Trade Memoranda.

During the month of September, Canada exported to Great Britain 2302 tons of copper ore.

Platinum and irridium have been discovered in the Mudgee district, New South Wales.

An additional small Siemens furnace of the new type is to be erected at Trubia, Spain.

A curved armour plate, hardened by the Harvey process, has been made at the Bethlehem Steel Works, Pennsylvania. It is 10½in. thick.

Messrs. Walker, Maynard and Co. have blown out their No. 1 furnace at the Redcar Ironworks, and have now only two in operation out of four erected.

Messrs. Steel, Peech and Tozer, Phœnix Bessemer Steel Works, Ickles, have had to suspend some portion of their operations in consequence of the damage caused to their property by the disastrous floods which completely inundated several parts of Yorkshire on October 16.

The St. Louis Stamping Company, of St. Louis, manufacturers of tinplate, are rolling all their black plates from billets made in Joliet and Belleville, Ill., and in Pittsburg. They have now in operation four sets of hot rolls and four cold rolls. The additions to the tin mill are now almost completed, when they will have six sets of hot rolls and twelve cold rolls. The capacity will then be increased to 800 boxes of plates per day from 400 as at present. The tin used comes from Australia or from the East India islands.

The Metal Market.

PRICES CURRENT.

LONDON, October 24.

COPPER opened with cash buyers at £45 15s., which was increased to £45 16s. 3d., and £45 6s. 3d. was bid for three months. Brisk buying, partly for consumption, kept values steady, cash being placed at £45 17s. 6d., and three months at £46 7s. 6d.; but when about 200 tons had changed hands prices began to droop, owing to a natural reaction under sales to realise, cash passing at £45 16s. 3d. to £45 15s., and November prompts, from 11th to 17th, at £45 17s. 6d. to £45 16s. 3d.; and, coupled with "jobbing" operations, three months moved after at £46 5s. to £46 3s. 9d., while on the curb cash was done at £45 12s. 6d. The close is quiet at 2s. 9d. to 5s. decline. Sales totalled 750 tons. Settlement price, £45 15s. English tough, £49 10s.; best selected, £50 10s.; strong sheets, £58.

TIN has ruled steady for immediate delivery, £95 being paid throughout, but in the absence of special influence sales of futures were made at reductions ranging from 1s. 3d. to 2s. 6d., three months realising £95 10s., and prompts, in the second half of November, £95 2s. 6d., and the close is quiet at rates unchanged to 2s. 6d. down. Sales, 100 tons Settlement price, £95. English ingots, £98 10s.

PIG IRON began with cash business at 41s. 5d., after which there were buyers of three months at 41s. 9d., and of one month at 41s. 6½d., but later in the day, in consequence of Glasgow advices, warrants declined, 41s. 6½d. being taken for one month, and the close was quiet at a loss of 1d. on the day. Sales, 1000 tons. Settlement price, 41s. 4d.

TINPLATES remain dull. I.C. cokes, f.o.b. London, 12s. 9d.; Liverpool, 12s. 3d.; Swansea, 11s. 9d.

LEAD is easier, Spanish being offered at £10 7s. 6d., with buyers at £10 6s. 3d. English, £10 12s. 6d.

SPELTER is firm, with ordinary for November shipment £19 sellers, and Silesian specials for November have been done at £19 2s. 6d.

ZINC SHEETS.—Silesian is firm and fairly active, with ordinary brands, ex ship, at £21 17s. 6d. Belgian steady. V.M., ex ship, £22 5s. f.o.b.; Antwerp, £22 sellers.

OFFICIAL CLOSING QUOTATIONS.

	£	s.	d.	£	s.	d.
COPPER—						
G. M. B.—Cash	45	15	0	46	2	6
" Three months	46	5	0	46	12	6
English tough	—			—		
Best selected	—			—		
Strong sheets	—			—		
TIN—						
Fine foreign—Cash	95	0	0	95	10	0
" " Three months	95	10	0	96	0	0
Australian—Cash	95	10	0	96	0	0
PIG IRON—					s.	d.
Scotch warrants—Cash					41	4
" One month					41	6½
Middlesbrough—Cash					Nom.	
" One month					—	
Hematite—Cash					Nom.	
" One month					—	

GLASGOW, October 24.—Business on the pig-iron market was very quiet to-day, only some 6000 tons being sold, all but 500 of which were Scotch. The tone was sluggish, and the close was at the lowest, representing a drop of ½d. in Scotch and 3½. in Cleveland and in hematite. The two last named were rather freely offered, both for cash and forward, but buyers, especially of hematite, were very scarce, owing to the depressed state of the steel trade. Shipments of Scotch last week, 7411 tons, an increase of 1185 tons on the corresponding week, and making the increase for the year 36,631 tons.

QUOTATIONS.

	Highest.		Lowest.	
	s.	d.	s.	d.
Scotch warrants—Cash	41	4½	41	4
" One month	41	6½	41	6
Middlesbrough—Cash	37	9	37	7½
" One month	37	8	37	8
Hematite—Cash	47	6	47	6
" One month	—		—	

New Companies.

BIRMINGHAM IRON AND STEEL-STAMPING COMPANY LIMITED.—This company was registered on the 13th inst., with a capital of £3000, in £1 shares, to carry into effect an agreement made between Mr. O. Ward of the one part, and this company of the other part, for the acquisition of the business hitherto carried on under the style of the Birmingham Iron and Steel-stamping Company, at Aston-lane, Aston, Warwickshire, and to develop and extend the same. Registered, without special Articles of Association, by Waterlow and Sons Limited, London-wall, E.C.

BROMYARD GAS, LIGHT, AND POWER COMPANY LIMITED.—This company was registered on the 19th inst., with a capital of £5000, in £10 shares (originally registered November 1, 1856, as the Bromyard Gas Company Limited), the objects being sufficiently indicated by the title. Registered under the Companies Acts, 1862 to 1890 October 19, 1892, as the Bromyard Gas, Light, and Power Co. Limited. Directors, Messrs. J. W. Williams and F. W. Williams, both of Bromyard, Herefordshire. Registered by Messrs. Jordan and Sons, 120, Chancery-lane, W.C. Registered office, W. H. Pumphreys, draper, Bromyard, Herefordshire.

ELIESON ACCUMULATOR (BRITISH PATENT) SYNDICATE LIMITED.—This company was registered on the 13th inst., with a capital of £12,000, in £1 shares, to acquire from C. P. Elieson certain patent rights relating to improvements in electric accumulators, in accordance with an agreement, particulars of which are not given; generally to carry on business as manufacturers of and dealers in electrical appliances and apparatus of every description. There shall be no less than three nor more than seven directors; qualification, £500; remuneration to be fixed in general meeting. Registered by Mr. A. Caillat, 6, Great Winchester-street, E.C. Registered office, 6, Great Winchester-street, E.C.

FORRESTT AND SON LIMITED.—This company was registered on the 19th inst., with a capital of £50,000, in £5 shares, to acquire the business of Messrs. Forrestt and Son (established in 1788), at Norway-yard, Limehouse, E., and the shipyard, Wyvenhoe, Essex, and elsewhere, ship, yacht, and boat builders and engineers, in accordance with an agreement expressed to be made between Mr. W. M. F. Schneider of the one part, and this company of the other part; generally to carry on the business as builders of vessels of all kinds, in particular steam yachts, river steamers, lighters, torpedo-boats, lifeboats, barges, rowing and electric boats, manufacturers of machinery, apparatus, and equipment for use in connection with vessels, in particular marine engines and pumps; as manufacturers of all kinds of machinery and apparatus for mining, quarrying, well-sinking, dredging, excavating, testing, and exploration purposes; as mechanical engineers, manufacturers of and dealers in timber, iron, steel, wire, rope, and hardware of all kinds; to lay out land for building purposes; to establish and maintain roads, ways, tram and railways, canals, docks, wharves, hydraulic, gas or electric works, factories, warehouses, etc.; as company promoters, stock and share dealers, and the general business of financiers. There shall be no less than three nor more than seven directors; the first are Messrs. W. M. F. Schneider, A. W. L. Trotter, C. Forster, H. W. Ridsdale, and W. Johnson; qualification, £2000; qualification of subsequent directors, £100; remuneration, £52 10s. Registered by Messrs. Dawes and Sons, 9, Angel-court, E.C.

Trade Marks.

The following is the Official List of Applications published from October 12 to October 19, for the Registration of Trade Marks, so far as relates to the Metal Trades.

CLASS 5.

VERBENA

166,863. Tinplates. THE ASHBURNHAM TINPLATE COMPANY LIMITED, Burry Port, R.S.O., Carmarthenshire; tin-plate manufacturers.—2nd September, 1892.

CLASS 13.

"The essential particular of the Trade Mark is the device, and the applicants disclaim any right to the exclusive use of the added matter, except their name and address."

166,235. Metal pulley blocks. ARNOLD GOODWIN AND SON, 56, Sumner-street Southwark, London, S.E.; engineers.—30th July, 1892.

CLASS 13.

"The essential particular of the Trade Mark is the combination of devices, and the applicant disclaims any right to the exclusive use of the added matter."

166,477. Ventilators (metal). ROBERT RENTON GIBBS, 259 to 263, Mill street Liverpool; engineer.—11th August, 1892.

Official Gazette.

Partnerships Dissolved.

R. and H. R. PONTIFEX, under the style of R. Pontifex and Son, Upper St. Martin's-lane, coppersmiths, cock founders, and plate makers' hot water and gas engineers.

J. E. BOTT and C. G. NORRIS, under the style of the Solid Steel Engineering Company, Openshaw, engineers and machinists.

J. F., R., and A. CLARKE, under the style of J. F. Clarke and Sons, Featherstone-street, St. Luke's, engineers.

THE BANKRUPTCY ACTS, 1883 AND 1890.

Receiving Orders.

W. J. and H. A. HAVARD, trading as W. J. Havard and Co., Maesteg, Glamorganshire, brass and ironfounders.

J. WADE, the Manor House, Wortley, near Leeds, engineer.

I. WOAFOLK, Leeds, late of Knottingley, Yorkshire, mercantile clerk, late ironfounder.

Adjudication.

W. LOCKWOOD (trading as W. Lockwood and Co.), Sheffield, engineer.

Miscellaneous Items.

The directors of the Barry Railway intend constructing an electric tramway at Barry Docks, South Wales.

The Commissioners of Northern Lights announce that the lighthouse on Fair Isle in the passage between the islands of Orkney and Shetland, which has been in course of construction for many months past, will be used for the first time at sunset on the evening of November 1, and that the light, which is a flashing one, will be shown regularly thenceforward from sunset to sunrise. The lighthouse is built on the N.E. promontory of Fair Isle called Kros, and will be of invaluable assistance to the great number of fishermen, British and foreign, who habitually use this passage, which is a very dangerous one.

The number of American electric rail roads has increased this year from 385 to 469.

The Inman steamer, "City of Paris," arrived at New York on the 19th inst., making the shortest western transatlantic voyage—namely, 5 days, 14hr. 24min., being 1hr. 34min. shorter than her previous shortest voyage. The best day's run, 530 miles, was on Tuesday, the 18th inst. For the whole voyage the hourly average was 20·7 knots.

The Dore and Chinley Railway, to connect Sheffield with Manchester by an easy route on the Midland, will be opened in June next. A great engineering feat has been accomplished in the Totley tunnel, which is 3½ miles long, without a single air-shaft. Many difficulties were encountered, and the fatalities have been numerous. The work will cost £1,000,000.

The Bolton Corporation has decided that the town shall be supplied with the electric light. The system adopted is to be also capable of running the trams, which will probably be taken over by the corporation at the expiration of the lease next year. The capital at present sunk in the gas undertaking is over £600,000, and the profits last year were £18,000.

The Administration of Posts and Telegraphs, which a short time ago took over the telephones in France, has just published a very interesting report, according to which there are now 112 towns in France provided with telephone communication. When the State took over the telephones, there were only 11,440 subscribers, whereas there are now 18,191, rather more than half of whom are in Paris.

Notwithstanding England's indebted-ness to her mechanics, only one mechanical working man has ever been honoured with burial in Westminster Abbey, and that was Graham, the clockmaker. Graham made exact astronomy possible by his great improvements and inventions in timepieces. Graham was also a maker of great quadrants and instruments of that sort. His funeral was attended by all the members of the Royal Society.

A new Corliss engine of 2400H.P. was started at the Fall River Ironworks, Mass., on October 9. It is of the twin triple-expansion type, and is said to be the largest in America. The diameter of its six cylinders are: Two 23½in., two 36½in., and two 54in. Its wheel is 25ft. in diameter, with 15ft. 4in. face. The rim of the driving wheel has a surface of 176in., and is covered by four belts—one 38in., two 44in., and one 50in. in width. They are all 3-ply belts.

An Italian firm of engineers, Messrs Carli and Co., claim to have invented a highly serviceable road car. Its length is 1·8 metre, the breadth 1 metre, the height 1·2 metre, and the weight 140kilos. The car has two seats and rests on two wheels fixed to the same axle. The drum is composed of steel tubes. The motive power is furnished by a battery of ten accumulators, weighing 70kilos., with a capacity of 20 ampère-hours per kilo. The car is fitted with electric lamps, bells, brakes, and steering gear.

M. J. B. Fondu, of Brussels and Vil-vorde, has designed a rotary furnace for heating bolts and rivets, consisting of three principal parts—viz., the foundation or stand, the ashpan, and the cupola or furnace proper, which is heated by coke. The advantages claimed for the system are:—Facility for cleaning; a sufficiently intense heating for supplying several machines at once; facility for fixing in the position most advantageous for work; friction reduced to a minimum in the rotation of the apparatus, through the application of anti-friction rollers; and the easy renewal of any damaged portion, owing to the whole apparatus being put together with bolts.

Queries.

☞ Readers are invited to avail themselves of this section for practical information on questions relating to Mechanical Engineering and the Scientific Industries.

☞ Queries and Replies should arrive at the Manchester Office not later than by the first post on the Tuesday preceding the date of publication.

CONVERTING GAS ENGINES.—Will any reader kindly inform me how to convert a Crossley's gas engine, 15H.P., slide-valve type, to a tube firing type?—FITTER.

SWEDISH BESSEMER STEEL.—Can any reader inform me how Swedish Bessemer steel is made, and also give highest amount of carbon it contains?—FORGEMAN.

COATING FOR WATER PIPES.—Can any reader tell me how to ascertain whether cast-iron pipes have been properly coated with Dr. Smith's solution?—WATER PIPE.

MOULDING SAND.—Will any reader inform me where the fine moulding sand is obtained which is used for making small malleable-iron castings in Walsall?—IRON FOUNDER.

HARDENING AND TEMPERING.—Can any reader inform me how to harden and temper a number of straight steel wires 13 gauge and 16in. long? I have tried several ways, but I cannot keep them straight. I may say that I have hardened them in oil, and one at a time.—BLACKSMITH.

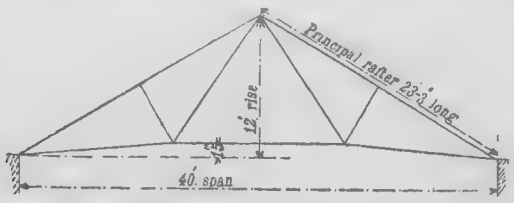
LOSSES IN STEEL FURNACES.—Could any reader kindly inform me the average per cent. of actual loss, and the average per cent. of skull, in the charge of a Siemens open-hearth steel furnace working charges of from 30 to 40 tons? And also the percentage of loss in heating slabs and ingots in the Siemens regenerative gas furnace?—J. R. P.

SPEED OF LOCOMOTIVES.—Provided a railway line is laid as perfect as possible, can any engine attain such a velocity as to cause it to leave the rails owing to excessive speed only?—P. T. G.

FLANGING PLATES.—Will any reader kindly let me know which is the best way to flange plates 2ft. 6in. diameter by ⅜in. thick? I must flange them by hand, as we have no flanging machine?—BOILER.

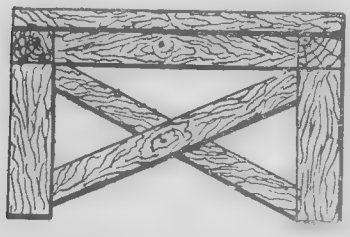
CASTING S SH WEIGHTS.—Would any reader favour me with information relating to the casting of sash weights in chills. It seems to me that it requires a very expensive plant, and is beset with many difficulties, such as (1) the chill, if made of cast iron and to receive a large number of weights, must be very weighty and cumbersome and not easy of manipulation, therefore incurring great loss of time; (2) the faces require planing and careful adjustment; (3) does not the coreing become awkward? (4) the chill must burn away by constant use; (5) a large quantity of useful metal is lying idle when the chills are not in use. I shall be pleased to receive any information as to a cheaper way of constructing chills, etc.—C. R. ROBERTS.

ROOF TRUSS.—Required to find the stress on each member of a wrought-iron roof truss, and also the best form of section to be used for each member—*e.g.*: if it was found that the cross sectional area of one of the tie rods



was 2in. square, would it be best to use a bar, say, 4in. by ½in., with the deepest part downwards, in preference to a round bar of equal area? Would it form a more rigid and stronger framework built up of flat bars and analogous sections, such as tee angle, channel etc., instead of bars of a round section? The weight of each truss I have assumed as 950lb. The load due to corrugated iron covering, etc., is 2lb. to the square foot, and to this I have assumed weight of snow to be 5lb. per square foot, allowing for it being 12in. deep, thus making it, say, 7lb. per square foot. I understand how to construct the diagram according to Clark Maxwell's method (p. 150, Molesworth's Pocket-book); but my chief difficulty is how to place the loads when knowing the weight of the framing and the load when given in so many lb. per square foot.—C. PERCIVAL.

WOOD STAGING.—How are the strains and sizes obtained of the timber platforms as sketched, supposing the framework to be, say, 10ft. square and 8ft. high, supporting a load of 4 tons? Under what conditions does it become necessary to use the diagonals, and



how are the requisite sizes arrived at? What is the best method of connecting? Should the diagonals pass one another, be halved, or one butt against the other?—STAGING.

CAMS AND BOWLS.—(1.) When subject to little pressure, studs work in the cam race without any roller or bowl on them. At what amount of pressure ought a roller to be used on the stud to work in the race? and how is the pressure on the stud to be calculated for a cam to turn rotary motion into to-and-fro straight motion if the groove or race is 12in. diameter and moves a bar 4½in. in each direction? (2.) What is the pressure on a wiper cam to lift 2cwt. at 1¾in. from shaft? and also, what is the strain on the cam shaft, and how can I find it for other wipers? (3.) What is the pressure on the ball bearing in a ball mill, and how is it found? The mill is to grind 75lb. at a time, and the ball works in a hemispherical footstep bearing and at end of inclined spindle, the top end of which makes a circle of 1ft. diameter in turning. Weight on spindle about 1 ton.—OATS.

LOCOMOTIVE CONSTRUCTION.—Will any correspondent enlighten me as to the mode adopted in locomotive work in order to fix the position of the axles (horizontally) so that each axle may have a predetermined portion of the total weight resting upon it? Say:—

Load on leading axle	.....	0·32
" driving "	.....	0·48
" trailing "	.....	0·20
		1·00

Of course I am aware there are certain circumstances—such as length of barrel, position of firebox, etc.—which in practice to a great extent influence this; but the point I wish clearing up is: Given the total weight, how are the positions of axles determined so that the prearranged weights rest on them? An answer would be of service to others as well as to—HILLSLAND.

Replies.

☞ Owing to the constant increase in our correspondence, we regret that we have no alternative but to announce that we cannot reply by post to Queries even when stamped envelopes are sent.

☞ Queries and Replies must in all cases be accompanied by the names and addresses of the writers, as no notice will be taken of anonymous communications.

A CONSTANT READER.—See reply to G. H. K.

OXONIAN.—Your query is too vague for insertion.

G. H. K.—You have omitted to enclose your address.

J. KENT.—We can only refer you to the War Office, Pall Mall, London.

W. MORRISS.—We have searched for the book you name, but fail to trace it.

W. P., Stoker.—It is quite *possible* for the furnace to collapse under the conditions stated.

A. CHEETHAM.—Messrs. W. T. Glover and Co., Salford, will, we think, supply the tools and give you full instructions.

J. WOHLBACH (Easton, Pa., U.S.A.)—There is no periodical published in this country devoted to mechanical drawing.

C. PERCIVAL.—You will find discs of leather bolted tightly between flanges keyed to the shaft answer well for the purpose.

ANXIOUS TO KNOW.—See our issues for May 18 and June 1, 1889. Also Bottone's "Electric Bells" (3s.), which may be had from our office.

JACK.—Your best plan is to read "First Principles of Mechanical Engineering," by Imray and Biggs (3s.). It may be had from our office.

W. M.—We do not quite see the point. If you evaporate 10,000lb. of water by burning 1120lb. of coal, you have 8·9lb. of steam per pound of coal.

YOUNG ENGINEER.—There is no book dealing with the points mentioned at any length. You will find some notes in "The Mechanical World Pocket Diary and Year Book" for 1893, which is now ready. See also Hutton's "Practical Engineer's Handbook."

H. DANBY.—(1.) Sketch B is geometrically correct, and is on the whole the plan generally adopted. (2.) One sq. ft. of pipe surface is required for 80 cubic ft. of space; 1 cubic ft. of boiler is required for 1500 cubic ft. of space; 1 H.P. boiler is sufficient for 40,000 cubic ft. of space.

ENGINE TENTER.—You do not appear to have sufficient data to compute the water used per I.H.P. You require to know the mean effective pressure, the clearance, the percentage of the return stroke done under compression, etc. The whole is very fully explained in our issue for May 10, 1890

LONG STROKE.—1.) A less number of reversals of the reciprocating parts, less loss by clearance and by compression, more even turning. (2.) Less time is given for the interaction to occur between the steam and the cylinder walls. Smaller, lighter, and to some extent cheaper engines may be used.

HORSESHOE NAIL MAKING MACHINERY.—Required the addresses of firms who are makers of this class of machinery.—*A.*—Messrs. Lander and Larsson, 164, Edmund-street, Birmingham, would like to communicate with you.

PLUMBERS' UNION.—Required the address of the secretary of the Operative Plumbers' Union.—PLUMBER.—*A.*—We should advise you to apply to the editor "Plumber and Decorator," Wellington-street, Strand, who will doubtless be able to give you full particulars.

CUTTING CHASERS.—Can any reader inform me what method is used by Sir J. Whitworth and Co. to cut up their screw chasers, both inside and out? Or can any reader advise me as to the best method of cutting up inside and outside chasers when high-class mechanical efficiency is required, such as would be necessary in making standard gauges? Is there any method by which one can ensure a chaser retaining its proper angle after going through the hardening process?—A. KIRBY.—*A.*—See reply to Horseshoe Nail Making Machinery.

SPEED OF FAN.—Can any reader give me a rule for calculating the speed a fan should run at to discharge a given quantity of air against a pressure of 2in. or 3in. of water. I mean in regard to fans such as are used on board ship?—B. E. J.—*A.*—The basis whereon to calculate the speed of a fan to discharge a given quantity of air against any given pressure is:—Water density = 1, air density = 770. Water at a velocity of 32ft. per second will support a "head" = 16ft., or an equivalent pressure of 7¼lb. per square inch. Air would require to move with a velocity = 770ft. per second to have the same effect. The make and shape of the fan and of its blades, the relation of the diameter of its supply pipe, and the depths, numbers, and lengths of the blades, and also the shape of the latter, would all have to be known before an exact reply to this query could be given; but from the basis, as above, the querist may learn the velocity at which air itself would require to be delivered to sustain, or to give out any pressure.—G. PENNINGTON, C.E.

Latest Inventions.

APPLICATIONS FOR LETTERS PATENT.

When Patents have been "communicated," the name of the communicating party is printed in italics.

Where complete specification accompanies application, an asterisk is suffixed.

10th October, 1892.

18,011 JOURNAL BEARINGS. E Kent.
18,012 WATER TAPS. C H Coe.
18,019 BEARING for SCREW PROPELLER and OTHER SHAFTS. W Y Streader.
18,020 GAS and OIL MOTOR ENGINES. J Southall.
18,024 RAILWAY SIGNALLING. C Hebblethwaite and J R Miller.
18,025 ELECTRIC ELEVATORS. A B See and W L Tyler.
18,032 LUBRICATORS. C E Skinner.
18,037 ELECTRIC WELDING APPARATUS. W C Mountain.
18,038 SLUICE VALVE. C Billington, sen., and J Newton.
18,039 ELECTROLYTIC CELLS and DIAPHRAGMS. J Hargreaves and T Bird.
18,047 DESTRUCTIVE DISTILLATION of OIL-YIELDING or GAS-YIELDING MINERALS, and the OBTAINMENT of PRODUCTS THEREFROM. N M Henderson and others.
18,066 ELECTRIC METERS. F W Golby. (*J A Dejardin*, France.)
18,069 POWER TRANSMITTING DEVICES.* J Walker.
18,070 AUTOMATICALLY OPERATING FIRE EXTINGUISHERS.* T F Handly.
18,074 ILLUMINATED SIGNALLING APPARATUS for MARINE or OTHER USE. A J Bailey.
18,076 VICE. C Bauer.
18,077 ELECTRIC SWITCHES.* H T Paiste.
18,082 REMOVAL of MANGANESE from PIG IRON, ETC.* C D Abel. (*Hoerder Bergwerks und Hütten-Verein*, Germany.)
18,084 MOUNTINGS for HEAVY GUNS. T English.
18,085 HOLLOW RAILWAY RAILS. R Mannesmann, jun.

11th October, 1892.

18,104 DRILL GRINDING GAUGE. H Packham.
18,109 GAS and OIL MOTOR ENGINES. J Southall.
18,111 HANDLES for FILES. F C Askham.
18,116 ELECTRIC ARC LAMPS.* W Mathiesen.
18,118 EXPLOSION ENGINES. T Gilbert-Russel.
18,124 ELECTRICAL DEVICE for the CONTROL of WORKMEN'S TIME CHECKS. H Davies.
18,125 METALLURGICAL FURNACES.* J N Lauth.
18,131 ADJUSTABLE SPANNERS and WRENCHES. J S Edge, jun.
18,133 MACHINE for CLEANING MINER'S LAMPS. M Wolstenholme.
18,142 CONDUITS for ELECTRIC RAILWAYS R Booth.
18,144 APPARATUS for PUMPING or RAISING LIQUIDS. E H Weatherhead.
18,146 HOT-WATER APPARATUS for HEATING PURPOSES.* H H Lake. (*R D Reed*, United States.)
18,153 PROPELLER for AERONAUTICAL PURPOSES. C Groombridge and W A South.
18,154 ELECTRIC ARC LAMPS. R Drysdale.
18,155 APPARATUS for HEATING WATER. J Rowley.
18,157 RECOVERY and UTILISATION of WASTE HEAT and GASES from GAS and OTHER FURNACES. T Williamson.
18,160 TELEPHONIC RECEIVERS. J P Annett.
18,163 MANUFACTURE of CAST IRON and STEEL, and APPARATUS THEREFOR. C Allen and C Davy.
18,165 TELEPHONIC APPARATUS. H H Lake. (*E Noriega*, Mexico.)
18,166 MICROPHONES. H H Lake. (*E Noriega*, Mexico.)
18,168 RENEWING the PERMANENT WAY of TRAMWAYS. W H Frankland and C F Dawson.
18,171 HYDROCARBON LIGHTING DEVICES.* F A Cody and L T Lawton.
18,179 CHECKING APPARATUS for TELEPHONES. O Schlicht.
18,181 ENGINES WORKED by FLUID PRESSURE. C F de Kierzkoroski-Steuart.
18,198 POWER HAMMER.* R W Barker. (*The Laird and Sweeney Manufacturing Company*, United States.)

12th October, 1892.

18,216 FILTRATION and PRECIPITATION of SEWAGE and IMPURE WATER. F P Candy.
18,220 PILE FABRIC for LUBRICATING PURPOSES. J Holdsworth and Co. and C Holdsworth.
18,236 APPARATUS for HEATING WATER. C J Chubb.
18,240 HYDRAULIC PRESSES for FORGING, ETC. G Hookham.
18,242 DYNAMO-ELECTRIC GENERATORS and MOTORS. T P Rennoldson.
18,244 PAPER BAG MACHINES. W Gilbert.
18,248 LUBRICATING the PISTON and VALVE RODS of ENGINES. J R Howden and H Johnson.
18,249 STUFFING BOXES of STEAM ENGINES. C McLaren.
18,251 STONE-BREAKING MACHINES.* G Dalton.
18,253 GLANDS of STEAM ENGINES. W Haycroft.
18,254 APPARATUS for BURNING LIQUID FUEL in STEAM GENERATOR and OTHER FURNACES. J Gwynne and M P Chepournoff.
18,257 TRIPLE-EXPANSION STEAM ENGINE.* H Davey.
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18,262 CULVERTS for ELECTRIC MAINS. W H Scott.
18,266 CUTTING or PLANING MACHINES. A J Boult, (*The firm of Otto and Krause*, Germany.)
18,269 PROTECTOR or LIFE-GUARD for TRAMCARS or ENGINES. C H Guest.
18,270 PORTABLE FUEL PLANT. A J Stevens.
18,275 TREATMENT of METALS in a FLUID STATE. M Lewthwaite.
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18,282 ROTATORY ENGINES and PUMPS. J Lewthwaite.
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18,288 ANCHORS. H Charlton.
18,292 PROCESS for the PRODUCTION of ALUMINIUM. H M Hyndman. (*J Vandessluys*, France.)
18,297 SIFTING COAL and in APPARATUS USED THEREIN. A Hegener.

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18,299 HARMONIC ANALYSER. A Sharp.
18,307 EXTRACTING GOLD, SILVER, and OTHER METALS from ORES. T F Barbour.
18,312 FEEDING, HEATING, and CIRCULATING of the WATER of STEAM BOILERS. J Gilmore.
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18,374 SIGHT-FEED LUBRICATORS.* W W Branston.
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18,389 ACCELERATING and CONTROLLING the SUPPLY of AIR to STEAM BOILER FURNACES, and in UTILISING the HEAT of the WASTE FIRE GASES. J Howden.
18,391 MANUFACTURE of ALUMINIUM, and APPARATUS THEREFOR. W Mills.
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18,407 MAKING and PRINTING PAPER BAGS. J S Birnesohn.
18,427 LATHE ATTACHMENT for CUTTING SCREWS. D F Levesque. (*R Norwell*, United States.)
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18,430 TOOTHED WHEEL. J Lindsay and C F Taft.
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18,442 IMPROVED PITCH or OTHER LADLE. C A Jensen. (*W M Walters.*)
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FRIDAY, NOVEMBER 4TH, 1892.

The Utility of the Steam Jacket.

IT is very questionable if anything pertaining to the steam engine has formed the subject of such long-continued controversy as the utility of the steam jacket. Innumerable experiments have been made from time to time with the object of deciding the question; but at present almost as much uncertainty prevails in the minds of engineers upon this point as in the early years of the century. Scores of able engineers are still to be found who consider the jacket only a useless appendage to the steam engine; but, on the other hand, those who hold the opposite view are probably well in the majority. Of late years several attempts have been made to collect the results of numerous experiments which have been undertaken by various investigators at different times, and if this method is concientiously pursued, the results should be highly instructive and interesting. Too often, however, the prevailing idea is to prove the case for or against the jacket, and we are much afraid that there is a great temptation to suppress some of the results which do not accord with the views of the investigators. One of the most complete and reliable collections of such data is being gradually compiled by a research committee of the Institution of Mechanical Engineers, the first report of which was issued in 1889. At the last meeting of the Institution the committee's second report was presented, and as it contains the particulars of a number of carefully-made experiments, we shall reproduce the greater portion of it. The general results obtained appear to be all in favour of the jacket, and the percentages of saving of feed water effected by its use are in some cases remarkably large. Some explanation of the widely different results which are obtained from very similar engines will probably be forthcoming when the behaviour of steam in an engine cylinder is better understood than at present.

Electric Omnibuses.

THE horse omnibuses are soon to disappear from the London streets. No longer shall we hear the heavy thud of the hoofs on the wood-paved thoroughfares, giving us warning of the approach of danger; the pleasantries between drivers of rival 'buses concerning the relative value of the horses will be a thing of the past, and "the great self-contained" moving practically without noise, will loom out of the fog and probably grind up the streets more than is the case at present. We are forced to these conclusions by a long article, possibly inspired, published in the columns of a metropolitan paper last week. How often have we been told that in a few weeks or months a line of electric omnibuses will be put into service? How often have we seen the "only one" making its perambulations along the streets? At least several times during the past four years. And now we are told again that "probably in a fortnight the latest electrical omnibus will be running." That this may be the case we sincerely hope, but we shall not be disappointed if events turn out otherwise. The last time we heard of the Ward 'bus, a service of twelve cars was to be inaugurated between Charing Cross and King's Cross; now the new type is to be placed on the Hammersmith route, where competition is severe and where there is a heavy gradient calculated to test the capabilities of an electric vehicle of any description. Licences will, we now understand, be granted for the operation of electric 'buses after they have been passed by the officials at Scotland Yard, similarly to those of the ordinary type. We shall await with deep interest the development of the latest scheme. It would, indeed, be remarkable if a self-contained electric 'bus should prove successful from a monetary point of view, when tramcars on the same system have hitherto been commercial failures. At any rate, if a number of electric omnibuses are to be started and worked on the lines proposed by the Electrical Power Storage Company, as mentioned in a previous issue, some interesting data from the service should be obtained.

New Chemical Processes.

TWO new chemical processes have recently been announced, the first of which is due to Mr. Ludwig Mond, who has devised a method of utilising the chlorine which hitherto has been wasted in the ammonia process of manufacturing caustic soda. Hitherto the ammonium-chloride solution has been boiled with lime, in order to recover the ammonia, the resulting products being gaseous ammonia and chloride of calcium. Until now the latter has been allowed to run off, carrying with it, of course, the chlorine derived from the brine (chlorine of sodium). The new system begins when bicarbonate of soda and ammonium chloride have been formed. The first having crystallised and been removed, the second is frozen by means of liquefied ammonia until it also crystallises. It is next dried and sublimed, the vapour being passed over magnesium oxide, which parts with its oxygen to form water with some of the hydrogen of the ammonium chloride, seizes the chlorine, thus becoming magnesium chloride, and allows free ammonia to pass on. Up to this point, therefore, the ammonia has been recovered as before, but is left with magnesium chloride instead of calcium chloride. The next step is to pass hot air over the magnesium chloride, the result being that that compound is again converted into magnesium oxide, while the chlorine is set free, and is turned into bleaching powder in the usual way. The second process has for its object the production of caustic soda direct from brine by means of electricity. This problem has long engaged the attention of chemists, but great difficulty has always been found in regard to the expensive anodes required for the decomposition of the brine, and which in turn were themselves rapidly disintegrated by the absorption of the nascent chlorine given off during the process. Another difficulty was to prevent the recombination of the products when once they had been separated. Mr. James Greenwood, the eminent electrochemist, has patented an important new departure by which both these difficulties are claimed to have been overcome. He has invented a compound anode of even greater conductivity than those hitherto employed, but treated in such a manner as to render it non-porous and unattackable by the chlorine, and therefore much longer-lived, whilst he has also devised a patent diaphragm which renders the recombination of the products impossible. The process has been worked on a commercial scale with success for some time in London.

The Overhead System.

WITH the inauguration just a year ago at Leeds of the first electric tramway on the overhead system of supply in this country, was commenced a new era of electric traction in the United Kingdom. The line, although promoted and carried out by Americans, will doubtless be the forerunner of many others, and for that matter, the leading spirit in that enterprise, Mr. Graff-Baker, is now negotiating for the operation of other lines on that system. In the meantime, the South Staffordshire Tramways Company have completed arrangements for the working of a portion of their lines with electric cars on the trolley system. These arrangements, due to the energy displayed by Mr. J. W. Carruthers-Wain and Mr. A. Dickenson, both of whom have personally investigated the various methods of dealing with street traffic in the United States, are now practically finished, and the service of electric cars is on the point of being started. The districts to be worked are Wednesbury, Bloxwich, Darlaston and Walsall. The lines have, we believe, hitherto been served entirely by steam cars, and have not proved remunerative. In 1889 the expenses per mile run amounted to 12·09 pence, and the receipts to 12·67 pence per mile run. The electric cars, which have been built by the Electric Construction Corporation, will, we have little doubt, considerably reduce the working expenses, and place the undertaking on a more substantial basis. We should be pleased to see a more favourable opinion held by local authorities and others concerning the overhead system of collecting the current for the propulsion of tramcars. Though, perhaps, unsightly for large cities, and therefore objected to by many, this method has the great redeeming feature of having been the most successful from every aspect; and we imagine that public prejudice against it will sooner or later be overcome, and that the method which fulfils every requirement in the way of rapid transit, regular service, and affords dividends to the shareholders, will meet with a good reception and satisfy even the most fastidious.

Purification of Town Water.

THE terrible ravages of the cholera epidemic in Hamburg have induced several scientific gentlemen to investigate the causes which led to the remarkably rapid spread of the disease in that town. It has been found that the bad condition of the potable water was the chief factor which caused the epidemic to so quickly devastate the homes of the people. At the same time there is little doubt that the general sanitary arrangements contributed their share in the matter. The Hamburg Senate, not desiring another outbreak next spring, is about to consider a method suggested for purifying the town water from the Elbe. The proposal has been made by the well-known Dr. Werner von Siemens, of Berlin, and is amplified by Dr. Heinzerling, of Frankfort-on-the-Maine. The scheme is, briefly, to erect machinery for the heating of the water in pipes to the boiling point before allowing the water to pass along the distributing mains for consumption by the people. Both typhoid and cholera bacilli are killed before even this temperature is attained, and by the adoption of this method it is expected that the risks of either disease would be reduced to a minimum. Leaving aside the first outlay, the expense to Hamburg, with its population of just over 500,000 persons, would be about £40,000 per annum, or only 1s. 7d. per inhabitant.

Scotch Shipbuilding in October.

NOTWITHSTANDING the fact that a large number of important yards are on short time, the production for October is exceedingly large. It does not look large, and certainly is much below what it was last month, but 12,500-ton Cunarders, particularly in these declining days, are few and far between. There are no "ocean greyhounds" in the total, and few vessels of first-rate importance — as a matter of fact only three of the steamers are over 1000 tons, and eight of them under 500,—but even a moderate aggregate, in which small fry predominate, is not to be despised. The inference that no better work could be obtained on remunerative contracts is accurate, but whether the real difficulty was the price of labour, which is now much reduced, remains to be seen. The orders of the month seem to prove that wages were disproportionately high, but until the announcements of contracts increase, both in number and importance, that is still open to question. The most important of the contracts went to Clydebank and Dumbarton. The orders for the two second-class Inman boats have at last been placed—one with Messrs. James and George Thomson Limited, Clydebank, and the other with Messrs. William Denny and Brothers, Dumbarton. The vessels are to be about 9000 tons each. Messrs. Chas. Connell and Co., Scotstoun, are to build a large passenger and cargo steamer for a Spanish firm, and Messrs. Russell and Co., Greenock, a duplicate vessel for the "Auchmountain" Company. A contract for a steel screw-steamer of 1600 tons and 800H.P. has been placed with the Grangemouth Dockyard Company by the Bahamas Steamship Company Limited. Machinery of 160H.P. is to be constructed by Messrs. John Cran and Co., Leith, for a trawler under construction in the yard of Mr. William Jarvis, Anstruther.

Scotch shipbuilders launched 21 vessels, of 19,138 tons, of which 17, aggregating 13,858 tons, were steamers, and 4, measuring 5280 tons, sailing vessels. To the total the Clyde contributed 14 steamers of 12,894 tons and 2 sailing vessels of 2950 tons, and the Forth 3 steamers of 964 tons and 2 sailing vessels of 2330 tons. The production of last October was 30,342 tons.

The vessels launched included a steel screw-steamer of 4300 tons, built by Messrs. Caird and Co., Greenock, for the Peninsular and Oriental Company; a steel screw-steamer of 3000 tons, built by Messrs. Scott and Co., Greenock, for the Ocean Steamship Company Limited, Liverpool; a screw-steamer of 1200 tons, built by the Ailsa Shipbuilding Company, Troon, for Messrs. Shepherd and Co., Bombay; a steel twin screw-steamer of 550 tons, built by the Fairfield Company for the Northern Lighthouse Commissioners; a steel barque of 1800 tons, built by the Grangemouth Dockyard Company for Messrs. William Blair and Co., Glasgow; and a steel barque of 1500 tons, built by the Ailsa Shipbuilding Company, Troon, for the Village Line. Of the total tonnage, 5395 were for London, 3820 for Liverpool, 500 for Manchester, 864 for other English ports, 800 for Dublin, 4750 for Clyde ports, 1550 for India, 300 for South America, 600 for Austria, and 530 for Australia. A launch of 29 tons was returned as "for foreign owners."

There were launched from the Clyde yards 16 vessels of 15,844 tons, of which 14, representing 12,894 tons, were steamers, and 2 of 2950 tons sailing vessels. To the total, Govan contributed 1124 tons, Whiteinch 1450, Renfrew and Paisley 1570, Bowling 400, Greenock and Port-Glasgow 7800, Ardrossan 800, and Troon 2700.

During the month Messrs. Fleming and Ferguson, Paisley, shipped for South America two sets of patent quadruple-expansion engines of 500H.P. each. Messrs. D. Rowan and Sons engined the twin-screw steamer "Botelho" and two trawlers.

Jones' Forging Hammer.

We give herewith two views of an improved forging hammer designed for use in place of the "oliver," and invented by Mr. J. Jones, 24, Canterbury-street, Ashton-under-Lyne. As will be seen from the sectional view (Fig. 2), the machine is operated by a treadle B, to which a vertical rod A is suitably connected. This vertical rod passes through a coiled spring C, which is prevented from buckling by a slotted sleeve placed inside the coils, and carried by the bracket as shown. A collar on the rod serves to compress the spring as the treadle is depressed by the foot of the operator. The hammer head is arranged to slide in suitable guides, and is actuated by means of the slotted vibrating lever attached to its upper end, as indicated, and resting near the centre of its length upon a roller carried by the rod A. The method of providing for the lateral vibration of the lever will be clear from the drawing. These hammers can be supplied with one or more heads as desired. The inventor will furnish additional particulars upon application.

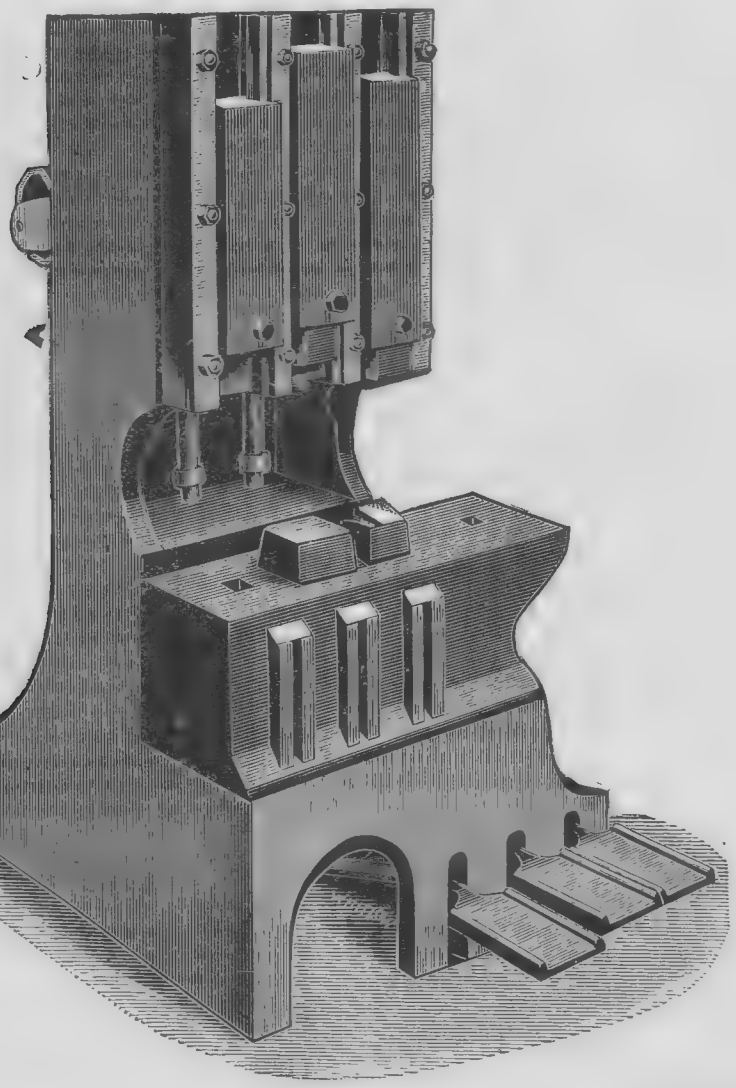
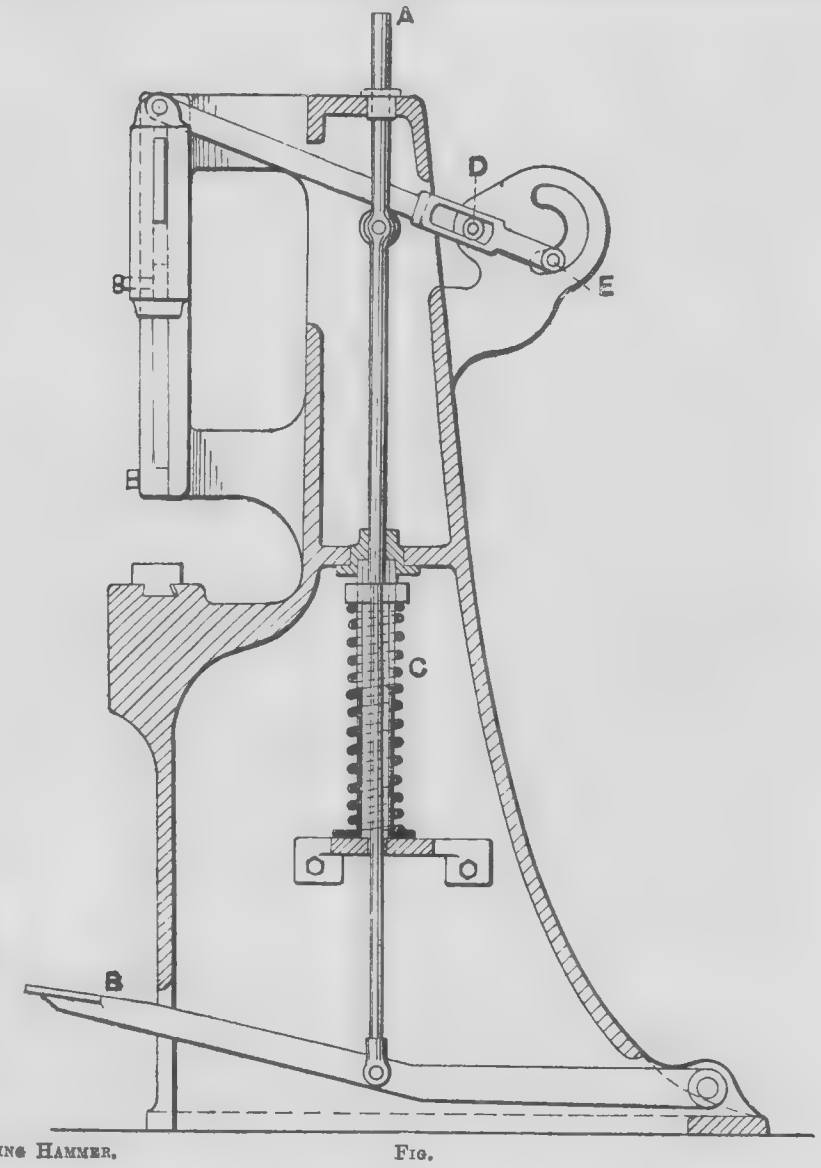


Fig.



Jones' Forging Hammer.

Fig.

Leeds Association of Engineers.

On Thursday, October 20, at the ordinary meeting of this association, the president (Mr. Robert Lupton) in the chair, a paper was read by Mr. Benjn. Holgate, F.G.S., on "Some Beautiful Mathematical Curves and their Application to Mechanics." Mr. Holgate explained the relation and properties of the series of curves known as conic sections by the aid of models and wall diagrams, and described their various applications in the construction of different kinds of beams for supporting weights; inlets and channels for water; injectors; reflectors for lighthouses and search-lights; the lines of expansion in indicator diagrams; the formation of vanes in fans and centrifugal pumps, etc. Mr. Holgate stated that if the proper curvature was employed in the construction of boiler flues and other air and water passages, less friction and greater efficiency would be the result. A discussion followed, in which Messrs. J. H. Wickstead, R. H. Wood, Scriven, Drake, Lupton and Whittle took part; and a vote of thanks to Mr. Holgate, proposed by Mr. Lupton and seconded by Mr. Wood, was carried unanimously.

From the Tannery to the Dynamo.*

It may be of interest to engineers, and to the electric-light fraternity in general, to learn something of how leather is tanned, and the various processes through which the hide passes before it is tanned and curried ready to be cut into belting. Naturally the first question will be, "Where do all the steer hides come from?" Principally from Chicago, because within its city limits there are four large slaughtering establishments where thousands of cattle are slaughtered daily, the hides of which are carefully taken off and assorted for whatever purpose they are best suited. The hides which are heaviest and most perfect in point of freedom from cuts, brands and other blemishes, are selected for belting leather. These hides are put up in bundles, packed into a freight car, and shipped to the tannery.

We propose to follow one of these freight cars loaded with belting hides to its destination. After a journey of about 600 miles, the car arrives at the little station of Adamsburg, Pa., right in the mountain region, a spur of the Alleghenies, where the tannery is situated.

Oak tanneries are generally placed near the bark region of the mountains, where the rock oak tree predominates, the bark of which is universally conceded to be the best for making the finest grade of leather. It is interesting to watch the mountaineers fell the huge oak trees, and skin the bark from the same. This is generally done in the springtime, and tanners have to purchase their year's supply during the bark-peeling season, which is from the middle of May to about the middle of June, according to the condition of the weather; the season seldom lasts over six weeks. If the sap rises into the leaves the bark cannot be taken off, and, therefore, oak trees are only cut down in that period.

The peeling of the bark is done whenever the trees are felled; the bark is gathered together in small stacks and covered to protect it from getting wet, because the strength of the tannic acid is lost by the bark getting wet; it must also be carefully guarded against mildew. Mountain fog is very damaging to peeled bark, therefore the mountaineers load the bark in wagons and deliver it as quickly as possible to the nearest tannery or railroad station.

However, our car of belting hides has arrived at the station, and we will watch the process of tanning. The hides are examined and weighed, and put into the shed; an equal number of hides are taken out daily (whatever the capacity of the tannery may be), and placed in a large vat of pure cold water, generally good spring water. After the hides are thoroughly soaked and the dirt washed out, they are laid across a beam, and with a blunt fleshing knife the surplus fat or meat still remaining is taken off. Then they are placed in a vat of weak lime-water, and are hauled up daily and the lime strengthened until the hair gets loose, which action takes about eight days. After this the hides are cleansed once more in pure water and placed over a beam, and with a blunt knife the hair is removed. This part of the work is done in what the tanners call the beam or lime house, and very much depends upon the successful liming process in making good leather.

After the hair is off, the hides are washed again and thoroughly cleansed and purified, to remove every particle of lime, after which process they are taken into the handlers. These are composed of large vats, about 7ft. by 9ft., and 6ft. deep. The hides here are laid across sticks side by side, as close as possible, and hung about 3in. below the top of the vat. These vats are generally connected so that when the first vat is fed the tannin liquor will pass through every vat until they are all filled, and cover the hides completely. In the handlers the hides receive their first bath of tannin liquor, which is very weak at the start, and gradually strengthened. During this first stage of tanning the hide plumps up, and is prepared for the lay-aways; this process also opens the pores and swells the hide, which gives thickness and firmness to the leather. If the hides cannot be made thicker at this period of the tanning, they will never be made heavier afterward; this is the critical point, and has to be watched closely. Much depends upon the character of the tannic acid; if too strong, it tends to make the leather brittle and harsh; if the tannic acid should be too sour, it tends to make the leather soft and flabby.

Some tanners use a rocking process to keep the hides in motion, thereby opening the pores of the hide quicker to receive the tannic acid. However, opinions differ as to the utility of the rockers; some claim (and justly) that the rocking motion loosens the fibre of the hide, and softens the leather too much. The best process is to simply hang them in the vats and cover them with the tannin liquor, and raise them a few times during the day, or draw the liquor through them, which some tanners are now doing with success.

The tannic acid in the handlers generally has a strength of from 5° to 15°, very seldom over 20°. The hides remain in that process from 10 to 12 days; they are then taken up, and if they are to be used for belt leather, the flanks (bellies) and heads of the hides are cut off and tanned separately; the remaining butt part receives an extra layer of bark to tan it more thoroughly and make it firmer.

From the handlers the hides are packed away in vats, called lay-aways; these are large vats, 7ft. by 9ft., and 6ft. deep, having a capacity of from 50 to 75 hides each. The vats are not connected with each other, but only with the pump to change the liquor. The hides are laid nicely one on top of another, and loose ground bark spread between each hide, and when the vat is full it is filled with tannin liquor of from 25° to 30° in strength. The hides intended for belting receive at least six layers of bark, or, in other words, are changed six times in the lay-aways; the first time they are changed after laying 10 days, and then 5 days are added after each layer, so that the hides in the last or sixth layer will take 40 days to absorb the tanning liquor and penetrate the leather. Each time fresh ground bark is spread between the hides, and then covered with tannin liquor.

(To be continued.)

* Paper by C. A. Schieren, read at the 15th Convention of the National Electric Light Association.

A deep boring of considerable interest to geological research, for which object it was carried out, has just been successfully brought to a completion at Mickleton Manor, Gloucestershire, by Messrs. Le Grand and Sutcliff, hydraulic engineers, London. After passing through some 121ft. of middle lias, marlstone sand and shales, the lower lias clays and limestones proved to be 1120ft. thick. Below these came the rhætic beds, and at 1315ft. the keuper marls were reached, into which the boring penetrated 27ft., gypsum being found in the last 2ft. The total depth of the boring is thus 1342ft., or over a quarter of a mile deep.

The Design and Construction of Stationary Engines.

XXXIX.

[ALL RIGHTS RESERVED.]

In Fig. 186 is shown a design of connecting rod used by Continental builders and taken from the "Machine Constructor." It is of flattened circular section, the crank-pin end being of the marine type. The crank-pin bearing of this rod is of cast iron lined with white metal. The cast-iron portion is provided with channelling or grooves, into which the white metal is run. The cast-iron bearings and the hole in the rod end are machined to suit, and the halves prevented from turning round by the bolts bolting the cap passing partly through the bearings. These bolts are recommended to be of fine grained wrought iron, and *not of steel*, as being more secure against shocks and vibrations. To ensure uniform elasticity throughout the bolts, they are bored up from the head as far as the commencement of the thread, so that they may have the same sectional area throughout. The diameter of the thread is made slightly less than the body of the bolt—viz., $T = 0{\cdot}9S - \frac{1}{16}$ fully. Thus a bolt $1\frac{3}{4}$in. diameter $= (1{\cdot}75 \times 0{\cdot}9) - 0{\cdot}07 = 1\frac{1}{2}$in. diameter. The depth of the nut = 2T. To prevent the nut from turning, the greater portion of it is turned circular, and is let into the cap with a groove turned in it for the point of the small set screw N to enter, which locks the nut in position, preventing it from turning. The rod is made tapered, and from about the middle to the crank end it is planed flat on the sides. The other end of the rod is fork-shaped to receive the crosshead pin, which is made with a double taper in the jaws and fixed by means of the screw and nut and locking piece. Both holes in the crosshead fork have the same taper, but they do not form a continuous cone. The nut is secured from turning by means of the safety pin and locking piece. The shape of the fork, it will be seen, lends itself to machine labour. The junction end of the rod with the fork is in the form of a sphere, while the side faces are machined flat. The making of the crank-pin end of the rod is similar to that already described for Fig. 182.

The end is forged in one piece, turned on the edges, the sides planed, the bolt holes and hole for the bearings drilled, then parted in two, the space required by the parting tool being made up by cast-iron filling-up pieces put between, which can be thinned as required when wear has to be taken up. Tables XXIII. and XXIV. give the leading dimensions for a number of sizes of these rods.

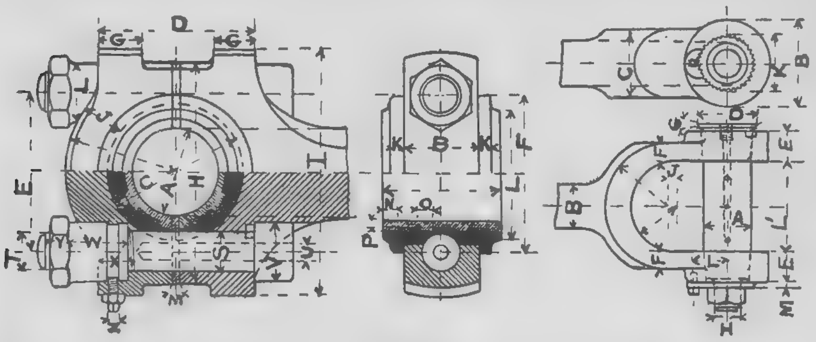


Fig. 186.

(To be continued.)

TABLE XXIII.—DIMENSIONS OF CONNECTING-ROD END—MARINE TYPE.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
2 3/4	2 5/8	4 3/16	5	5	5	1 3/8	6 7/8	7 11/16	1 1/2	3/8	4 1/8	5/16	5/8	7/16	1/4	3/8	3/4	1 1/4	1 1/16	5/8	1 15/16	1 5/8	3/4	7/8	1/4
2 15/16	2 9/16	4 1/2	5 5/16	5 5/16	5 5/16	1 3/8	7 1/4	8 1/4	1 9/16	3/8	4 5/16	5/16	5/8	7/16	1/4	3/8	3/4	1 5/16	1 1/8	21/32	2 1/16	1 3/4	3/4	7/8	5/16
3 5/32	2 3/4	4 13/16	5 11/16	5 11/16	5 11/16	1 9/16	7 7/8	8 7/8	1 11/16	7/16	4 1/2	3/8	5/8	7/16	9/32	7/16	3/4	1 13/32	1 1/4	11/16	2 3/16	1 7/8	7/8	15/16	5/16
3 3/8	2 15/16	5 1/8	6 1/8	5 15/16	5 15/16	1 9/16	8 1/4	9 1/4	1 3/4	1/2	4 15/16	3/8	5/8	1/2	9/32	7/16	3/4	1 1/2	1 5/16	3/4	2 1/4	2	15/16	1	5/16
3 9/16	3 5/32	5 3/8	6 3/8	6 3/8	6 3/8	1 3/4	8 11/16	9 3/4	1 13/16	9/16	5 1/8	3/8	11/16	1/2	9/32	7/16	7/8	1 9/16	1 13/32	25/32	2 13/32	2 1/8	1	1	5/16
3 3/4	3 5/32	5 11/16	6 11/16	6 11/16	6 11/16	1 3/4	9 1/4	10 1/4	1 7/8	9/16	5 1/2	3/8	11/16	1/2	9/32	15/32	7/8	1 11/16	1 15/32	13/16	2 1/2	2 1/4	1 1/8	1 1/16	5/16
3 15/16	3 11/32	5 7/8	7 1/16	7 1/16	7 1/16	1 15/16	9 5/8	10 13/16	1 15/16	9/16	5 11/16	3/8	11/16	1/2	5/16	15/32	7/8	1 3/4	1 1/2	7/8	2 5/8	2 3/8	1 3/16	1 1/8	3/8
4 1/8	3 7/16	6 1/4	7 1/2	7 1/2	7 1/2	1 15/16	10 1/4	11 1/4	2 1/16	5/8	6 1/8	3/8	11/16	1/2	5/16	15/32	7/8	1 13/16	1 19/32	15/16	2 3/4	2 1/2	1 1/4	1 1/8	3/8
4 5/16	3 3/4	6 5/8	7 11/16	7 11/16	7 11/16	2 3/16	10 5/8	11 13/16	2 1/8	5/8	6 1/4	3/8	3/4	5/8	5/16	15/32	1	1 7/8	1 5/8	1	2 13/16	2 5/8	1 5/16	1 1/8	3/8
4 1/2	3 15/16	6 3/4	8 3/16	8 1/16	8 1/16	2 3/16	11	12 3/16	2 1/4	5/8	6 11/16	7/16	3/4	5/8	5/16	1/2	1	2	1 11/16	1	2 15/16	2 3/4	1 3/8	1 3/16	3/8
4 3/4	3 15/16	7 1/16	8 1/4	8 1/4	8 1/4	2 3/16	11 5/8	12 3/4	2 3/8	11/16	6 7/8	7/16	3/4	5/8	3/8	1/2	1	2 1/16	1 3/4	1	3 1/16	2 7/8	1 7/16	1 3/16	7/16
4 15/16	4 1/8	7 3/8	8 11/16	8 11/16	8 11/16	2 3/8	12	13 3/16	2 7/16	11/16	7 1/16	7/16	3/4	5/8	3/8	1/2	1	2 1/8	1 7/8	1	3 5/32	3	1 1/2	1 1/4	7/16
5 1/8	4 5/16	7 11/16	9 1/16	9 1/16	9 1/16	2 1/2	12 5/8	13 3/4	2 9/16	11/16	7 1/2	7/16	1	3/4	3/8	1/2	1 3/16	2 3/16	1 7/8	1 1/8	3 1/4	3 1/8	1 9/16	1 1/4	7/16
5 1/2	4 1/2	8 1/4	9 5/8	9 5/8	9 5/8	2 9/16	13 3/16	14 3/4	2 3/4	3/4	7 7/8	1/2	1	3/4	3/8	9/16	1 3/16	2 3/8	2 1/16	1 3/16	3 1/2	3 3/8	1 3/4	1 5/16	7/16
5 15/16	4 15/16	8 7/8	10 1/4	10 1/4	10 1/4	2 3/4	14 3/16	15 3/4	2 15/16	3/4	8 1/2	1/2	1	3/4	3/8	9/16	1 3/16	2 9/16	2 3/16	1 5/16	3 3/4	3 11/16	1 7/8	1 3/8	1/2
6 1/4	5 5/16	9 3/8	11	11	11	2 15/16	15 3/16	16 3/4	3 1/8	15/16	9 1/16	1/2	1 1/16	1	3/8	9/16	1 3/8	2 3/4	2 13/32	1 5/16	4 1/16	4	2	1 1/2	1/2
6 11/16	5 11/16	9 15/16	11 5/8	11 5/8	11 5/8	3 1/8	15 13/16	17 3/4	3 3/8	15/16	9 5/8	1/2	1 1/16	1	7/16	5/8	1 3/8	2 15/16	2 9/16	1 3/8	4 5/16	4 5/16	2 1/4	1 9/16	1/2
7 1/16	5 7/8	10 1/2	12 3/8	12 3/8	12 3/8	3 1/8	16 15/16	18 11/16	3 9/16	1	10 1/4	1/2	1 1/16	1	7/16	21/32	1 3/8	3 1/8	2 3/4	1 1/2	4 5/8	4 5/8	2 7/16	1 21/32	1/2
7 1/2	6 1/4	11	13	13	13	3 3/8	17 15/16	19 11/16	3 3/4	1 1/8	10 5/8	1/2	1 1/16	1	1/2	11/16	1 3/8	3 1/8	2 3/4	1 1/2	4 5/8	4 5/8	2 7/16	1 23/32	5/8
7 7/8	6 11/16	11 5/8	13 9/16	13 9/16	13 9/16	3 9/16	18 7/8	20 11/16	3 15/16	1 1/8	11 1/8	9/16	1 1/8	1 1/16	1/2	11/16	1 9/16	3 3/8	2 15/16	1 9/16	4 7/8	5	2 5/8	1 3/4	5/8
8 1/4	6 5/8	12 3/16	14 3/8	14 3/8	14 3/8	3 3/4	19 11/16	21 5/8	4 1/8	1 3/16	11 9/16	9/16	1 1/8	1 1/16	1/2	3/4	1 9/16	3 9/16	3 1/8	1 11/16	5 5/32	5 1/4	2 3/4	1 13/16	5/8
8 11/16	7 1/4	12 3/4	15	15	15	3 15/16	20 11/16	22 5/8	4 5/16	1 1/4	12 5/8	5/8	1 1/8	1 1/16	1/2	3/4	1 9/16	3 3/4	3 5/16	1 3/4	5 7/16	5 19/32	2 15/16	1 7/8	3/4
9 1/16	7 11/16	13 3/8	15 3/4	15 3/4	15 3/4	3 15/16	21 5/8	23 5/8	4 1/2	1 1/4	13	5/8	1 3/16	1 1/16	9/16	3/4	1 3/4	3 15/16	3 15/32	1 7/8	5 11/16	5 23/32	3 5/32	2	3/4
9 7/16	7 7/8	14	16 3/8	16 3/8	16 3/8	4 1/8	22 5/8	24 5/8	4 3/4	1 3/8	13 3/16	5/8	1 3/16	1 1/16	9/16	13/16	1 3/4	4 1/8	3 11/16	1 15/16	6	6 1/4	3 11/32	2 1/16	3/4

TABLE XXIV.—DIMENSIONS OF CONNECTING-ROD ENDS (CROSSHEAD ENDS).

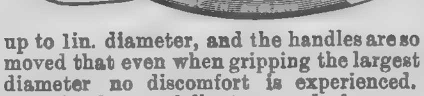
A	B	C	D	E	F	G	H	I	J	K	L	M
2	3 3/8	2 3/4	2 9/16	1 3/8	11/16	3/8	1 5/16	1/4	5/16	2 3/8	1 1/2	1/4
2 3/16	3 15/16	3 1/8	2 13/16	1 3/8	11/16	7/16	1 5/16	1/4	5/16	2 9/16	1 9/16	1/4
2 3/8	4 3/8	3 3/8	3 5/32	1 9/16	3/4	1/2	1 3/8	1/4	3/8	2 13/16	1 3/4	1/4
2 9/16	4 3/4	3 9/16	3 9/16	1 3/4	7/8	9/16	1 9/16	5/16	7/16	3 1/16	1 7/8	1/4
2 3/4	5 1/8	3 15/16	3 3/4	1 3/4	1	9/16	1 9/16	5/16	7/16	3 5/16	2	9/32
3	5 1/2	4 1/8	3 15/16	2	1	19/32	1 3/4	5/16	1/2	3 9/16	2 3/16	9/32
3 3/16	5 3/4	4 1/2	4 3/16	2 3/16	1 1/8	5/8	2	3/8	9/16	3 3/4	2 3/8	5/16
3 3/8	6 1/8	4 3/4	4 1/2	2 3/16	1 1/8	11/16	2	3/8	9/16	4	2 1/2	5/16
3 9/16	6 1/4	4 13/16	4 3/4	2 3/8	1 3/16	11/16	2 3/16	7/16	5/8	4 1/4	2 11/16	3/8
3 3/4	6 7/8	5 5/16	5 1/8	2 3/16	1 1/4	3/4	2 3/8	7/16	5/8	4 1/2	2 13/16	3/8
3 15/16	7 1/16	5 1/2	5 5/16	2 9/16	1 3/8	3/4	2 3/8	7/16	11/16	4 3/4	2 15/16	3/8
4 1/8	7 1/2	5 7/8	5 1/2	2 3/4	1 3/8	13/16	2 9/16	1/2	11/16	4 15/16	3 1/8	7/16
4 3/8	7 7/8	6 1/8	5 7/8	2 15/16	1 1/2	7/8	2 9/16	1/2	3/4	5 5/16	3 1/4	7/16
4 1/2	8 1/4	6 5/16	6 1/8	2 15/16	1 9/16	29/32	2 3/4	1/2	3/4	5 1/2	3 3/8	1/2
4 3/4	8 11/16	6 11/16	6 1/4	3 1/8	1 9/16	15/16	2 3/4	1/2	3/4	5 3/4	3 9/16	1/2
4 15/16	9 1/16	6 7/8	6 11/16	3 11/32	1 11/16	1	2 15/16	5/8	13/16	6	3 11/16	1/2
5 1/8	9 7/16	7 1/4	6 7/8	3 11/32	1 3/4	1	3 1/8	5/8	13/16	6 1/4	3 7/8	9/16
5 1/2	10	7 11/16	7 1/4	3 3/4	1 7/8	1 1/8	3 5/16	5/8	15/16	6 1/2	4 1/8	5/8
5 7/8	10 5/8	8 1/4	7 7/8	3 15/16	2	1 3/16	3 9/16	3/4	1	7	4 3/8	5/8
6 1/4	11 7/16	8 7/8	8 7/16	4 1/8	2 1/16	1 1/4	3 3/4	3/4	1 1/16	7 1/2	4 3/4	11/16
6 11/16	12	9 7/16	9	4 5/16	2 3/8	1 5/16	4 1/8	3/4	1 1/8	7 3/4	5	11/16
7	12 9/16	10	9 7/16	4 3/4	2 5/8	1 7/16	4 3/8	7/8	1 3/16	8 1/2	5 5/16	3/4
7 1/2	13 3/8	10 5/8	10	4 15/16	2 9/16	1 1/2	4 1/2	1	1 1/4	8 7/8	5 9/16	3/4
7 7/8	14 3/16	11	10 7/16	5 1/8	2 3/4	1 9/16	4 3/4	1	1 5/16	9 7/16	5 15/16	3/4

Institute of Marine Engineers.

A meeting of the Institute of Marine Engineers was held in the premises of the Institute, 58, Romford-road, on Monday evening, the 24 thult., when the discussion, "Our Firemen," was resumed. The chair was occupied by Mr. Coubro (member of council). The proceedings were opened by the chairman, who referred to the general tone of the discussion at the last meeting, implying the need of reform in the stokeholds of steamships. He advocated continuous service for firemen, who were often found useful in overhauling machinery when in port, and incidentally alluded to a practice adopted by the French Government of granting pensions according to service to firemen employed in the mercantile navy of that country. The following members took part in the discussion — namely, Messrs. White, Nicoll, A. W. Robertson, R. Leslie, N. McLean, Alderman Kidd, the hon. secretary, and others. It was pointed out that improved education doubtless would lead to a better class of men coming forward, but that there would be no radical change for the better until there was some opportunity given for improving their position. The adoption of continuous certificates was a means in that direction, thereby enabling them when qualified to compete for a Board of Trade certificate. Reference was made to improved accommodation and diet for firemen on board a certain line of steamers, resulting in a superior class of men being attracted to that service. Englishmen were generally considered as superior to other nationalities in point of ability and reliability in the hour of danger, an instance being quoted when in a typhoon in the China seas, the vessel having 7ft. of water in the stokehold. In the speaker's opinion, had that vessel been manned with Asiatics, in all probability she would have foundered with all on board. The question of the continuous discharge sheet was considered a matter requiring the attention of the Board of Trade. The consensus of opinion was not favourable to the elevation of a fireman to an engineer, whether qualified by service or not. The training for the latter could only be obtained through the shop. The interesting discussion was brought to a close with the usual vote of thanks. It was announced that arrangements were being made to hold a mechanical drawing class in connection with the institute, and that members desirous of attending should send in their names to the hon. secretary as early as possible.

The "Footprint" Pocket Gas Plier.

Mr. Thos. R. Ellin, 185, Rockingham-street, Sheffield, has just introduced a new and handy form of gas plier, of which an illustration is given herewith. It is made on Mr. Ellin's double-box jointed system, with hollow handles, which, in addition to securing lightness and strength, also fit the hand comfortably. The jaws are made so as to be capable of gripping from a gas burner

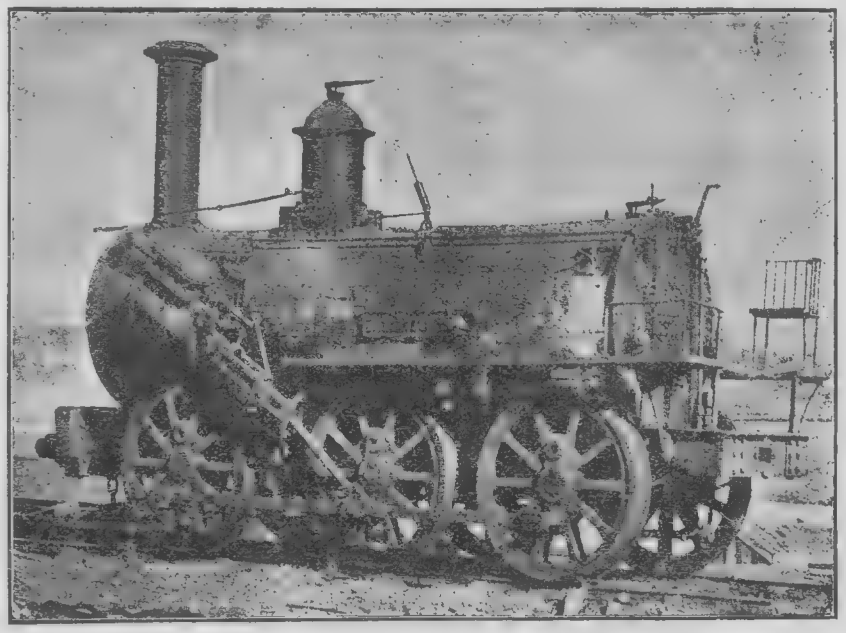


up to 1in. diameter, and the handles are so moved that even when gripping the largest diameter no discomfort is experienced. One shank, carefully tempered, forms a turn-screw, while the other serves for opening the ends of lead pipe, etc. As will be noticed, the turn-screw shank is made somewhat longer than the other, so that it can be used without opening the handles. The tool is suitable for the pocket, is well made and finished, and as it is supplied at a reasonable price it will undoubtedly become popular with working gasfitters and others.

The s.s. "Abarenda," recently launched from the yard of Messrs. Edwards' Shipbuilding Company Limited, Howdon-on-Tyne, had a successful trial trip on the 19th ult., when a mean speed of $10\frac{3}{4}$ knots was obtained. The dimensions are: — Length over all, 326ft.; breadth extreme, 42ft.; moulded depth, $28\frac{1}{2}$ft. The engines were made by Messrs. R. and W. Hawthorn, Leslie and Co., of St. Peter's, and are of the triple-expansion type, with cylinders 23in., 38in., and 62in. diameter, by 42in. stroke.

An Old Locomotive.

At the present time, when the controversy as to the relative merits of English and American locomotives is being so keenly carried on, the following remarks taken from an American contemporary may prove of interest:—"The accompanying illustration is from a photograph of the engine Albion in the possession of the Acadia Coal Company, Stellarton, Novia Scotia. The engine was built by Rayne and Burn, of Newcastle-on-Tyne, in 1853 or 1854, and was used on the coal lines in the vicinity of Stellarton from that date until 1886, when it was finally retired from service. That an engine of such design should have kept in service up to such a recent date speaks well for it, and corroborates the statement of the railway officials that it had proved a most satisfactory locomotive.



An Old Locomotive.

It weighs about 16 tons, and in its design shows marks of those gradual improvements on the first engines which led up to the modern locomotive. It has an engine frame, and its cylinders are placed at the front end of the engine. They are also inclined instead of vertical, as in the Sampson and others, and connections are made to the middle pair of drivers. The return flue boiler is also absent, and in all these respects the engine exhibits the beginning of the drift towards the modern design, while still retaining many features of the first crude designs. This engine is still capable of being operated with low-pressure steam."

Comparison of Friction in Cotton-mill Engines and Gearing to the Actual Work Done.*

In bringing this subject before your notice I feel it is one that is deserving of our attention, and I trust it will be the means of enabling us to do something to prevent the loss of power and economy which exist in engines and gearing at the present time from this cause.

Thurston says: "Friction is a resistance which is always met when two bodies or particles, whether solid, liquid, or gaseous, are compelled to move, one upon another. There are three kinds of friction, so called; rolling and sliding with solids, and fluid friction with liquids and gases. These are all governed by different laws, and with each the statement of those laws as usually given in the text-books probably requires some modification." It is not my intention to attempt to analyse the different kinds of friction created in engines and gearing. I shall deal with all kinds of friction under the general head of Friction. It will also be impossible for me to furnish minor details of such engine and gearing arrangements that I shall refer to, as time and space will be occupied in a general description.

I have not been successful in obtaining permission to indicate some of the engines I had intended, and in one or two cases of refusal perhaps the least said the better. You will no doubt agree with me that running large engines up to their ordinary working speed without weight on, is not a very desirable thing, and is occasionally productive of hot bearings, which I believe is the true explanation of consent being withheld in some instances.

* Paper read by Mr. Alfred Saxon, before the Manchester Association of Engineers.

In the examples I shall refer to I have not attempted to select very extreme cases, such as I know do exist, but I have tried to select examples which will fairly illustrate mill engines and gearing which have been constructed within a comparatively recent date. Economies are being effected in steam engines at the present time by utilising higher pressures of steam, but we shall not be long in reaching a safe working limit in that direction.

There is no doubt that along with this increase of pressures we have had an increase of speeds in engines and gearing. We, as an industrial people, are drawing rapidly upon the coal supply, and if we must leave coal for the use of the generations yet unborn, and at the same time cheapen the cost of our productions, we must in our different positions as practical engineers, consulting engineers, and mill architects, in drawing up specifications and carrying them out, use every available means of improving the efficiency of the engines and gearing of our manufactories. There are a variety of ways of judging of the economy of steam engine and gearing, the commonest being the number of pounds of coal per indicated horse-power per hour, another test being that of the weight of steam used; these, however, are only partial tests. The test which many mill owners apply in a rough-and-ready sort of way—that of reckoning the number of spindles of either twist or weft, or both, and the counts of the yarn and the weight spun for a given quantity or value of coal, in comparison to their neighbours who have similar mills,—is a good proof of economical working, if taken into consideration with the tests above mentioned.

In the term "actual work," in the examples given, I wish it to be understood that I include all the power absorbed in driving the machinery, after deducting the friction of the engines and gearing from the total load—that is, treating the friction in the machinery itself and the work done by the machinery as "actual work."

If the coal consumption were based on the actual work done it would give some startling results, as is shown by a study of the following examples:—

SPUR-GEARING ENGINES.

Example 1.—Pair of horizontal compound tandem engines with high-pressure cylinders 24in. diameter, low-pressure cylinders 48in. diameter, all 5ft. 6in. stroke, making 51 revolutions per minute, or a piston speed of 561ft. per minute.

Fly spur-driving wheel 14ft. 6½in. diameter, 5in. pitch, 18½in. broad, 110 teeth; pinion 6ft. 7in. diameter, 50 teeth.

Indication with full load and boiler pressure of 110lb. works out to 1309·6I.H.P.

Indication of friction with the whole of the gearing and engines at work equals 385·76I.H.P., being 29·47 per cent. of the total load, leaving an actual load of 70·53 per cent. on the engines.

Description of gearing: Wheel and rope driving partly new and partly old, not supplied by engine maker.

Example 2.—Pair of horizontal compound tandem engines with high-pressure cylinders 21in. diameter, low-pressure cylinders 42in. diameter, all 6ft. stroke, making 35½ revolutions per minute, or a piston speed of 426ft. per minute. Fly spur-driving wheel.

Indication with full load and boiler pressure of 110lb. works out to 989·54I.H.P.

Indication of friction with the whole of the gearing and engine at work equals 217·49I.H.P., being 22 per cent. of the total load, leaving an actual load of 78 per cent. on the engines.

Description of gearing: Wheel and rope driving new, not supplied by engine maker.

Example 3.—Pair of horizontal compound engines, with high-pressure cylinder 16in. diameter, low-pressure cylinder 28in. diameter, both 4ft. stroke, making 70 revolutions per minute, or a piston speed of 560ft. per minute. Fly spur wheel.

Indication with full load works out to 250I.H.P.

Indication of friction with the whole of the gearing and engines at work equals 87·62I.H.P., being 33·2 per cent. of the total load, leaving an actual load of 67 per cent. for the engine.

Description of gearing: Old.

N.B.—The friction at 64 revolutions per minute equals 73·17I.H.P.

Example 4.—Pair of horizontal compound engines, with high-pressure cylinder 30in. diameter, low-pressure cylinder 54in. diameter, both 6ft. stroke, making 41 revolutions per minute, or a piston speed of 492ft. per minute.

Fly-wheel, 19ft. diameter; spur-driving wheel, 15ft. 0⅜in. diameter, 5in. pitch, 16in. broad, 114 teeth; pinion 5ft. 5½in. diameter, 41 teeth.

Indication of full load with a boiler pressure of 65lb. works out to 802·6 indicated horse-power.

Indication of friction with the whole of the gearing and engines at work equals 285·5 indicated horse-power, being 35·6 per cent. of total load, leaving 64·4 per cent. actual load.

Indication of friction of engines only equals 82·9 indicated horse-power, being 10·3 per cent. of total load.

Description of gearing: Wheel and rope driving. Power taken off the engines by spur-driving wheel and pinion, and distributed as follows:—One weaving shed driven by wheels. No. 2 shed driven by ropes followed by wheels. A cardroom driven by ropes, followed by wheels.

Example 5.—Pair of horizontal triple-expansion tandem engines, with high-pressure cylinders 14½in. diameter, intermediate cylinders 23in. diameter, low-pressure cylinders 36½in. diameter, all 6ft. stroke, making 51 revolutions per minute, or a piston speed of 612ft. per minute.

Fly spur-driving wheel 14ft. 8⅝in. diameter, 4½in. pitch, 18in. broad, 115 teeth; pinion 6ft. 7⅛in. diameter, 52 teeth.

Indication of full load with boiler pressure of 160lb. works out to 1044·5I.H.P.

Indication of friction with the whole of the gearing and engines at work equals 205·95I.H.P., being 19·7 per cent. of the total load, leaving 80·3 per cent. actual load.

Description of gearing: Wheel gearing throughout.

N.B.—Engines formerly compound. Recently tripled.

Example 6.—Pair of horizontal compound engines, with high-pressure cylinder 27in. diameter, low-pressure cylinder 48in. diameter, both 5ft. stroke, making 50½ revolutions per minute, or a piston speed of 502·5ft. per minute.

Fly-wheel 18ft. diameter; spur-driving wheel 13ft. diameter, 5in. pitch, 15in. broad, 98 teeth; pinion, 6ft. 3½in. diameter, 48 teeth.

Indication of full load with a boiler pressure of 100lb. works out to 840·55I.H.P.

Indication of friction with the whole of the gearing and engines at work equals 201·45I.H.P. at 45 revolutions per minute, being 24 per cent of total load, leaving 76 per cent. actual load.

Indication of friction in the engines only at 50 revolutions equals 50·85I.H.P., being 6 per cent. of total load.

Description of gearing: Wheel and rope driving. Power taken off the engines by spur-driving wheel and pinion, on end of second-motion shaft a rope pulley having 12 ropes drives about 390I.H.P.; the rest of the power is distributed by wheels.

Example 7.—Pair of horizontal compound tandem engines, with high-pressure cylinders 24in. diameter, low-pressure cylinders 48in. diameter, both 6ft. stroke, making 36 revolutions per minute, or a piston speed of 432ft. per minute.

Indication of full load works out 1008 I.H.P.

Indication of friction with the whole of the gearing and engines at work equals 263I.H.P., being 26 per cent. of the total load, leaving an actual load of 74 per cent. on the engines.

Example 8.—Pair of compound McNaughted beam engines, high-pressure cylinders 35in. diameter, by 3ft. 6in. stroke; low-pressure cylinders 42½in. diameter, by 7ft. stroke, making 33 revolutions per minute, or a piston speed of 462ft. per minute for the low-pressure pistons.

Fly spur wheel, 25ft. diameter, 4½in. pitch, 16in. broad, 210 teeth; pinion, 6ft. 1in. diameter, 51 teeth. Rim speed, 2590½ft. per minute.

Indication of full load with a boiler pressure of 90lb. works out to 1150I.H.P.

Indications of friction with the whole of gearing and engines at work equals 209I.H.P., being 18·17 per cent. of the total load, leaving 81·83 per cent. of an actual load on the engine.

Description of gearing: Wheel gearing throughout; mule-driving direct from line shafts.

Example 9.—Pair of triple-expansion engines with four cylinders, one high-pressure 23½in. diameter, one intermediate-pressure 35½in. diameter, one low-pressure 39in., and one low-pressure 43 1/16in., all 6ft. stroke, making 35½ revolutions per minute, or a piston speed of 426ft. per minute.

Fly spur wheel 19ft. 11in. diameter, 5⅜in. pitch, 19in. broad; pinion 6ft. diameter, 42 teeth.

Indication of full load with boiler pressure of 160lb. works out to 1145I.H.P.

Indication of friction with the whole of gearing and engines at work equals 300I.H.P., being 26·2 per cent. of the total load, leaving an actual load of 73·8 per cent. on the engine.

Description of gearing: Wheel gearing throughout.

N.B.—Formerly compound, recently tripled.

Example 10.—Pair of compound McNaughted beam engines, high-pressure cylinders 35in. diameter by 3ft. 6in. stroke, low-pressure cylinders 46in. diameter by 7ft. stroke, making 29 revolutions per minute, or a piston speed of 406ft. per minute, for the low-pressure pistons. Fly spur wheel.

Indication with full load at boiler pressure of 64lb. works out to 821·26I.H.P.

Indication of friction with the whole of gearing and engines at work equals 207·96I.H.P., being 25·3 per cent. of the total load, leaving 74·7 per cent. of an actual load on the engine.

ROPE-DRIVING ENGINES.

Example 1.—Pair of horizontal compound side-by-side engines, high-pressure cylinder 32in. diameter, low-pressure cylinder 60in. diameter, both 7ft. stroke, making 52 revolutions per minute, or a piston speed of 728ft. per minute.

Rope pulley 34ft. diameter, grooved for 32 ropes. Speed of ropes 5554·3ft. per minute.

Indications of full load with boiler pressure of 94lb. per square inch work out to 1272I.H.P.

Indication of friction with the whole of the gearing and engines at work equals 298I.H.P., giving 23·3 per cent of friction, leaving an actual load of 76·7 per cent. Friction at 50 revolutions equals 270·3 I.H.P.

Gearing new, but not made by engine maker.

Example 2.—Horizontal compound tandem engine, high-pressure cylinder 22in. diameter, low-pressure cylinder 44in. diameter, stroke 5ft., making 58½ revolutions per minute, or a piston speed of 585ft. per minute. Rope pulley 28ft. diameter, grooved for 16 ropes, 1¾in. diameter, 10 ropes only being used. Speed of ropes, 5146·9ft. per minute.

Indications of full load with boiler pressure of 100lb. work out to 724·9I.H.P.

Indications of friction with the whole of gearing and engines at work equal 232 1I.H.P., giving 32 per cent. of friction, leaving 68 per cent. actual load.

Description of gearing: New, but badly arranged to assist in driving part of another mill. Twenty-four ropes 1¾in. diameter used in driving, in addition to main shafts. Not supplied by engine maker.

Example 3.—Pair of horizontal compound side-by-side engines, high-pressure cylinders 24in. diameter, low-pressure cylinders 48in. diameter, both 5ft. 6in. stroke, making 62 revolutions per minute, or a piston speed of 682ft. per minute.

Rope pulley 24ft. diameter, grooved for 24 ropes 1¾in. diameter; speed of ropes, 4674·7ft. per minute.

Indications of full load with boiler pressure of 110lb. work out to 859I.H.P.

Indication of friction with the whole of gearing and englnes at work equals 274·2I.H.P. giving 32·8 per cent. of friction, leaving 67·2 per cent. actual load.

Description of gearing: Old, altered to suit rope driving; was previously arranged for belt driving.

Example 4.—Pair of horizontal compound tandem engines, with high-pressure cylinders 22in. diameter, low-pressure cylinders 44in. diameter, all 5ft. stroke, making 55 revolutions per minute, or a piston speed of 550ft. per minute.

Rope pulley 28ft. diameter, grooved for 28 ropes 1¾in. diameter; speed of ropes, 4838ft. per minute.

Indications of full load with boiler pressure of 90lb. work out to 1025I.H.P.

Indications of friction with the whole of gearing and engines at work equal 324·93I.H.P., giving 31·7 per cent. of friction, leaving 68·3 per cent. actual load.

Description of gearing: New, not supplied by engine maker.

Example 5.—Pair of horizontal compound tandem engines, with high-pressure cylinders 20in. diameter, low-pressure cylinders 40in. diameter, all 5ft. stroke, making 60⅜ revolutions per minute, or a piston speed of 603½ft. per minute.

Rope pulley 28ft. diameter, grooved for 26 ropes 1¾in. diameter; speed of ropes, 5306ft. per minute.

Indications of full load with a boiler pressure of 90lb. work out to 978·25I.H.P.

Indications of friction with the whole of the gearing and engines at work equal 283 I.H.P., giving 28·9 per cent. of friction, leaving 71·1 per cent. actual load.

Description of gearing: New, not supplied by engine maker.

Example 6.—Pair of horizontal compound tandem engines, with high-pressure cylinders 20in. diameter, low-pressure cylinders 40in. diameter, all 5ft. stroke, making 57 revolutions per minute, or a piston speed of 570ft. per minute.

Rope pulley 28ft. diameter, grooved for 24 ropes 1¾in. diameter; speed of ropes, 5013·9ft. per minute.

Indications of full load with a boiler pressure of 90lb. work out to 992·96 I.H.P.

Indications of friction with the whole of the gearing and engines at work equal 310·1I.H.P., giving 31·2 per cent. of friction, leaving 68·8 per cent. actual load.

Description of gearing: New, not supplied by engine maker.

Example 7.—Horizontal compound tandem engine, high-pressure cylinder 19in. diameter, low-pressure cylinder 38in. diameter, 5ft. stroke, making 62 revolutions per minute, or a piston speed of 620ft. per minute.

Rope pulley, 21ft. diameter, grooved for 16 ropes 1¾in. diameter; speed of ropes, 4092ft. per minute.

Indications of full load work out to 393·5I.H.P.

Indications of friction with the whole of gearing and engine at work equal 126·8I.H.P., being 32·3 per cent. of the total load, leaving an actual load of 67·7 per cent. on the engine.

Example 8.—Pair of horizontal compound tandem engines, high-pressure cylinders 27in. diameter, low-pressure cylinders 46in. diameter, all 5ft. 6in. stroke, making 75 revolutions per minute, or a piston speed of 825ft. per minute.

Rope pulley 22ft. diameter, grooved for 40 ropes 1¾in. diameter; speed of ropes, 5183 6ft. per minute.

Indications of full load with a boiler pressure of 100lb. work out to 1579·52 I.H.P.

Indications of friction with the whole of gearing and engines at work equal 389·4 I.H.P., being 24·6 per cent. of the total load, leaving 75·4 per cent. of an actual load on the engines.

N.B.—This engine is not fully loaded; the shafting and engines were fixed to turn 2000I.H.P. The friction at this power equals 19·47 per cent.

New gearing supplied by the maker of engines.

(To be continued.)

Shipbuilding Notes.

Messrs. B'shop, Miles and Co., Bristol, launched, on the 22nd ult., a steel twin-screw steamer. The dimensions are:—Length, 65ft.; breadth, 10ft.; and depth, 6ft. 9in. They have also orders for two similar steamers.

Messrs. M'Ilwaine and M'Coll Limited launched, on the 27th ult., from their shipyard in Queen's-road, Belfast, a twin-screw steamer 92ft. long, 16½ft. broad, and 7ft. depth of hold. The vessel has been fitted with compound surface-condensing engines, with cylinders 7in. and 14in. diameter by 9in. stroke. She was launched complete and ready for sea.

The screw steamer "Bathori," built by Messrs. Wigham, Richardson and Co., at their Neptune Works, Newcastle-on-Tyne, went a very successful trial trip off the Tyne on the 26th ult. She is 285ft. in length by 38ft. beam, and is fitted with triple-expansion engines, which, with the boilers, have also been constructed by the firm above named.

On the 25th ult. Messrs. Wm. Simmons and Co. launched complete, from their yard at Renfrew, a powerful twin-screw hopper dredger, constructed to the order of the Blyth Harbour Commissioners. Her dimensions are:—Length, 180ft.; breadth, 35ft.; depth, 14ft. A hopper is provided amidships capable of containing 700 tons of debris. She is propelled by two independent pairs of compound surface-condensing engines of about 800I.H.P.

On the 28th ult. the screw steamer "Powderham" left the yard of her builders, Sir Raylton Dixon and Co., Middlesbrough, for her official trial trip, which was in every way most successful. Her principal dimensions are:—Length over all, 327ft.; beam, 41ft.; depth moulded, 29ft.; and she has a deadweight carrying capacity of over 4600 tons. The engines have been fitted by Messrs. Thomas Richardson and Sons, of Hartlepool, the cylinders being 24in., 38in., and 64in. diameter, by 42in. stroke.

The steel petroleum screw steamer "Cadagua," built by Messrs. Armstrong, Mitchell and Co., at their Walker shipyard, was taken to sea for a trial trip on the 20th ult. The principal dimensions of the vessel are:—Length, 305ft.; breadth, 39ft.; and depth, 26ft. 6in. She has a deadweight carrying capacity of about 3400 tons. The triple-expansion engines were supplied by the Wallsend Slipway and Engineering Company Limited, and worked satisfactorily without a hitch on a trial of six hours' duration.

Messrs W. Doxford and Sons Limited, Pallion, Sunderland, launched, on the 22nd ult., a large steel screw steamer. The vessel is 465ft. long, 52ft. broad, and 36ft. deep, has a gross register of 6400 tons, deadweight capacity of 9250 tons on 25ft. draught, and gross displacement of 13,600 tons. The engines, also built by W. Doxford and Sons Limited, have cylinders 30in., 49in., and 78in. diameter by 51in. stroke, and are supplied by steam from three double-ended boilers, and will drive the vessel when fully loaded at a speed of 10½ knots.

North-East Coast Institution of Engineers and Shipbuilders.

THE first general meeting of the graduate section of the North-East Coast Institution of Engineers and Shipbuilders was held on the 13th ult., in the Institution Rooms, St. Nicholas' Buildings, Newcastle. The president, Mr. R. L. Gaine, A.Sc., was in the chair, and amongst those present was Mr. Robert Thompson, president of the institution.

The secretary (Mr. W. Oxton) read the annual report, which stated that the proceedings in connection with the section during the past year had been highly successful. A lively interest had been taken in the excursions, and in the reading and discussion of papers. Since its inauguration the section had made steady progress, and with increased membership there were bright hopes held out for the future. The report was unanimously adopted.

The president then delivered his inaugural address, in the course of which he said :—In a congregation of students such as this—for students we may undoubtedly be considered, in that we are preparing ourselves for the practice of a particular occupation — the general tenour of the papers or discussions should be instructive and educational rather than discursive. They may be both ; but I would imply that, valuable as a recapitulative or discursive paper may be, the time at our disposal would be better occupied by describing some structure, or particular detail or condition of a structure, which the speaker has had exceptional opportunities of observing—opportunities such as are denied to the generality of his fellows. Ordinary structures capable of straightforward description can always be read up from text-books ; but the transactions of an institution such as this contain matters which are taken up by the writers just at the point where the books leave off. And it is only by the careful and painstaking discussion of such that the most complete knowledge of a subject may be obtained.

After tracing the history of the institution from its inception to the present time, the speaker said :—I would now wish to take you for a few moments apart altogether from ourselves, and would ask you to consider the aspect of things in general.

It is a matter of extreme regret that we are now entering, or perhaps I should say have already entered, upon a period of very great financial depression. What its extent may be it would be vain to attempt to predict, but we can at least review in a cursory manner some of the events which have led up to it, as it more immediately concerns shipbuilders and engineers.

I think we may group all these under three heads : (1) Labour troubles ; (2) foreign competition ; (3) bad trade.

I have given No. 1 the premier position, as I consider it the factor of the most pressing importance, and the one on which the other two depend.

We do not need to go farther than our own district to both see and feel the baneful effects of strikes and lock-outs.

The result of such strife, whichever way it may go, would not seem to be so detrimental to the interests of the trade of the district as the effect of the actual existence of a struggle. Heading No. 2—foreign competition. I know it is frequently asserted that we need not fear foreign competition, that our superior skill, prestige, etc., etc., can afford to set it at defiance ; but, gentlemen, I am sure there are many of you who must know that it is a power to be reckoned with, and not a constant or determinate adversary of which we can gauge the strength and possibilities, and thereby take means to overcome them, but one that is ever-present and ever-growing, and which must, as a matter of absolute necessity, be taken into consideration. And it is during the existence of these labour troubles of which I spoke that foreign competition becomes most painfully apparent.

I know, from personal contact, of actual instances where orders have gone into a foreign market owing to local employers of labour not being able—owing to the uncertainty of the labour element in their calculations—to give any guarantee of a date of completion of the order.

Now, I do not wish to assert for a moment that Continental employers are not subject to the same embarrassments as we are here, but I would point out that it is a matter with which we have no concern ; the fact remains—and we must face it—that they can undersell us.

3. Bad trade may be said to be the direct outcome of low and unremunerative rates of freight. Low as they are, however, there are types of ship which can take them and yet profit by it ; and while this is so it would seem almost hopeless to expect a change for the better, as by far the greater portion of the steamships now in existence can only utilise them at a dead loss—indeed it is asserted by some shipowners that unless freights take an entirely phenomenal and unnatural rise this type of ship will never run to earn another penny.

As a necessary consequence of this dulness of freights, there are few orders being placed for new vessels, and the outlook for the winter is most cheerless. A short time ago there was a great impetus given to the building of large sailing vessels, but this would seem to have spent itself ; and perhaps we may consider that it has been overdone, that the demand has been met, and the market glutted — as in the case of steamships. As showing the acuteness of the distress on the Clyde, I have it on the authority of a shipping paper that platers and riveters are offering their services as labourers, and glad to get work of any kind to do for any wage. And yet these are the very men who, when trade is good, cause nearly all the trouble by their exorbitant demands.

In opposition to the general state of ignorance that prevails among working men on the subject of industrial political economy, it is interesting to note an incident which took place recently—an incident which may truly be described as "a gem sparkling in the midst of almost Stygian darkness." It is reported that at a trades union meeting of the servants of a large British railway company, one of the speakers is stated to have said that "the wages of the employés depended on and varied with the profits of the company, and that if servants demanded big wages, profits were small, and wages and the demand for labour consequently rapidly declined."

This is refreshing, and shows hopeful signs of a dawning though tardy intelligence, and is in strong contrast to the position recently taken up by another body of men—viz., that prices could be artificially regulated, and an increased value be put upon an article of production by restricting that production over a very small proportion of the total area in which it was produced.

I refer to the miners' play day. I have since learnt with much pleasure that this has been put an end to by order of the executive, they being convinced of its inefficacy

(To be continued.)

The Probable Future of Iron-making.

THE first ordinary meeting of the South Staffordshire Institute of Iron and Steel Works Managers for the present session was held at the Mechanics' Institute, Dudley, on October 29, when the president (Mr. T. Turner, of Mason College) delivered an inaugural address dealing principally with the questions of waste of fuel and metal in present processes, and the direction of probable future improvements in the manufacture of iron. He pointed out that there are still considerable differences in the loss of iron at various forges. While a number of manufacturers are satisfied to produce a ton of puddled bar with the use of 23cwt. of pig iron, or even more, others, with apparently no special advantages, can regularly make a ton of bars with a loss of less than 1cwt. of the iron charged. If a globule of cast iron be melted in the air and then exposed to a blast of air or oxygen, it will be observed that the impurities are not the only substances that are oxidised, but the iron itself is oxidised in about the same relative proportion as the other elements, and a layer of impure magnetic oxide of iron is formed outside the globule, while the portion of metal that is left is of nearly the same composition as the original iron. If the cinder is allowed to run away as rapidly as it is formed, ultimately the whole of the iron would be converted into magnetic oxide, and the last particle of cast iron so removed would have nearly the same composition as the original metal. In this case oxidation has taken place, but no purification has resulted. If now the same experiment be tried, but the fluid oxide be allowed to remain and to cover the fused metal, the oxidation of the iron will proceed very little further ; a reducing action will then be commenced whereby the silicon, carbon, and other easily-oxidisable elements will be removed, but at the same time a corresponding weight of iron will be returned to the globule from the surrounding slag. But if, again, a globule of cast iron be covered with magnetic oxide of iron to protect it from the air, and to supply the necessary cinder, and it be then strongly heated, it will be found that the globule has not lost in weight, but has become distinctly heavier during the process. The waste which takes place during reheating or remelting corresponds to the first condition above given ; the oxide runs away as it is formed, and this is an example of waste of iron pure and simple. The only redeeming feature is that sometimes the oxide produced may be of value for other purposes. The early open-hearth processes for producing wrought iron in fineries, and the original method of puddling, resemble the second case, for part of the iron is wasted to produce the cinder needed to remove the impurities from the remainder of the metal. The larger the proportion of these impurities the greater will be the loss of iron necessary to make the required cinder, and for this reason a comparatively pure iron is needed in order to reduce the waste, while at best the waste is comparatively great. A deficiency of fluid cinder in the early stages of puddling has an exactly similar effect, and leads to waste for the same reasons. In the modern method of working, the object is to imitate the conditions of the third case previously supposed. Oxide of iron can be bought much more cheaply than it can be made from pig iron, and the oxidation of pig iron requires the expenditure of time and fuel. Oxide of iron is therefore supplied in its cheapest form, and as much of this oxide as possible is reduced and converted into wrought iron. The Bessemer process of steel-making possesses the inherent disadvantage of corresponding to the second case above given, for part of the cast iron is oxidised and wasted in order to provide cinder for the purification of the remainder. The Siemens open-hearth process, on the other hand, comes under the third class of reaction ; since the oxidation is largely conducted by means of added, and therefore cheap oxides, the yield per ton of pig iron is greater. This greater yield is obtained from two sources —first, a diminution of the waste due to atmospheric oxidation of pig iron, and secondly, the addition of iron reduced by the carbon and silicon of the pig iron from the ore charged. The great disadvantage of the Siemens process in these days of rapid production is the length of time required for the treatment of a charge. The necessity for the use of ordinary fuel is also a drawback in the Siemens process. On the other hand, in the Bessemer process, large volumes of gas are forced through the molten metal, and thus carry off much heat which at present cannot be utilised in any way, and which is produced by the combustion of costly materials such as carbon, silicon, and iron, all of which are purchased at the price of pig iron. In those Bessemer works in America where the use of iron with little silicon, and rapid working, has led to largely-increased outputs, the reduction of waste has been carried as far as it is at present practicable. One of the greatest difficulties hitherto experienced has been in obtaining intimate mixture between the two interacting materials, cast iron and fluid oxide. In the puddling process this is accomplished with great manual labour, while a similar result is obtained in a Siemens furnace with lengthened time. In both cases it is noticed that heat is generated in the furnace by the reaction that takes place. The puddler is aware that heat is produced in the charge itself during the boil, and in the Siemens furnace the gas consumption is reduced during the period of most rapid carbon removal. That considerable heat is produced is also evident from a consideration of thermo-chemical data. If, then, fluid cast iron were brought into intimate contact with fluid oxide of iron, and the reactions which ensue could be caused to take place with sufficient rapidity, no external heat whatever would be needed, no blast of air would be required, but the materials would remain fluid from the heat generated by the reaction itself. And it may be specially noticed that this heat would not be accompanied by a waste of iron as in the Bessemer process, but by an actual addition of iron to the charge by the reduction of the fluid oxide employed. Such a process would possess one great additional advantage over any at present in use, for it would be capable of removing not only carbon and silicon, but also the phosphorus present in the pig iron. The ideal process of the future, therefore, is one that would be capable of treating all classes of pig iron, that would consume no external fuel, and that would be capable of treating large quantities of material in a short time ; and a further essential condition of working should be that no cast iron is wasted for the production of fluid cinder. On the small scale Mr. Stead has obtained good results by simply shaking the materials together violently in a red-hot crucible, and possibly by similar means good results might be obtained on the larger scale. If, say, a large covered vessel, heated by a preceding operation, were charged with fluid cast iron, and also with the necessary quantity of fluid oxide of iron, melted in a separate furnace, and, after properly closing this vessel, it were violently agitated so as to produce a froth or emulsion of the two liquids, the reaction would be complete in a very short time ; heat would be evolved, and the iron and cinder would remain perfectly fluid so as to be poured out at the completion of the charge. Silicon, carbon, phosphorus, and other impurities would be removed without waste, but with an actual increase in weight of iron charged, and no ordinary fuel and no forced blast would be needed. Enormous practical difficulties connected with wear and tear and similar matters would doubtless have to be encountered and overcome in carrying out such a process on the large scale, but it was in this direction that future developments were to be sought. In conclusion, Mr. Turner suggested that local institutes might do a good work in placing the highest metallurgical training within reach of even the very poorest persons engaged in various branches of the metal trades, by the provision of scholarships for students of proved industry and ability. It is probable that, in thus putting the highest facilities within the reach of a few really capable men, selected from the masses without regard to wealth or position, a greater good would be done to the individual and to the nation by the proper training of one man than by the very incomplete training of many.

Trade Notes.

The Creusot Works, France, have obtained an order for 12 steel guns from the Japanese Government.

The firm of Ganz and Co., electrical engineers, of Budapest, have recently added to their already large works an electro-chemical laboratory.

Messrs. Ruston, Proctor and Co. announce the payment of an interim dividend of 5s. per share for the half-year ended September 30 last.

Messrs. Fraser and Fraser, of Bromley-by-Bow, have been granted the contract for the supply of new steam boilers to the Mina-road School of the London School Board.

Messrs. Brown, Marshall and Co., of Saltley, have just built a most luxurious train for the P. and O. service, to run between Calais and Brindisi.

Mr. J. Jackson, of Penrith, has secured the contract for the supply of cast-iron pipes, valves, hydrants, etc., required for the waterworks at Longmarton and Brampton, Westmorland.

It is stated that the Dumbarton Forge Company will supply most of the plates for the new Inman liner contracted for by Messrs. William Denny, Brothers and Co., Dumbarton.

Messrs. Hammond and Co., of London, have secured the contract for installing with electric light the new extension of the Wagon Works of the Great Northern Railway Company at Doncaster.

The Hon. W. J. Lynes, Minister of Public Works in New South Wales, has decided to accept a local tender for the supply of 20,000 tons of iron pipes. The price arranged exceeds that of imported pipes by 15 per cent.

The Electrical Power Storage Company have secured a contract for the supply of storage batteries to the new station in Carnaby-street, London, recently opened by the St. James's and Pall Mall Electric Light Company.

Mr. A. Bainbridge, iron and steel merchant, Stockton-on-Tees, has bought the North Yorkshire Ironworks, situate at Thornaby-on-Tees, and until recently occupied by the South Stockton Iron Company. The works, which contain a large quantity of valuable machinery, will shortly be dismantled.

The Monmoor Ironworks, Wolverhampton, carried on for a long period by Messrs. Wright and Sons, makers of bars, plates, sheets, and hoops, were offered for sale by auction at Wolverhampton on the 26th ult. They are equal to producing 350 tons per week. The highest bid was £7200, at which they were withdrawn.

Readers of "The Mechanical World" are invited to send to the publisher of "Good Health," the new weekly paper devoted to food, drink, medicine, and sanitation, for a parcel of specimen copies, which will be sent gratis and post free, for distribution among their friends at home and abroad. Address, 391, Strand, London, or New Bridge-street, Manchester.

Wheel cutter in metal only. Every description of gearing. R. CHIDLAW, 43, City-road, Manchester.

Having regard to the enormous circulation of THE MECHANICAL WORLD, the Editor suggests that it is by far the best medium for the insertion of every kind of "Wanted" advertisement, and the price is only one halfpenny per word. The Editor will be glad if MECHANICAL WORLD readers will kindly bear this in mind as occasion arises.

CORLISS ROLLING-MILL ENGINE

FOR THE PACIFIC ROLLING MILL COMPANY, SAN FRANCISCO.

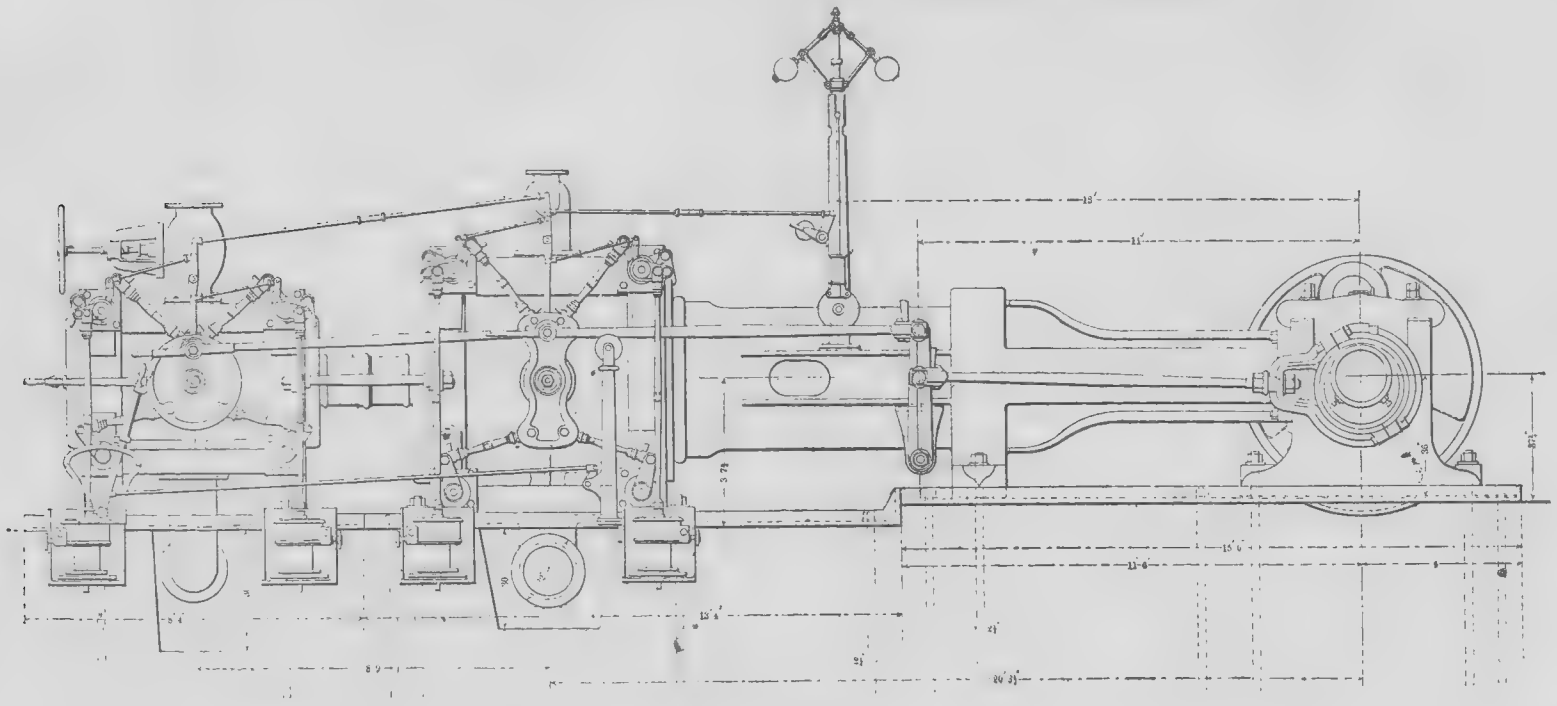


FIG. 1.—ELEVATION.

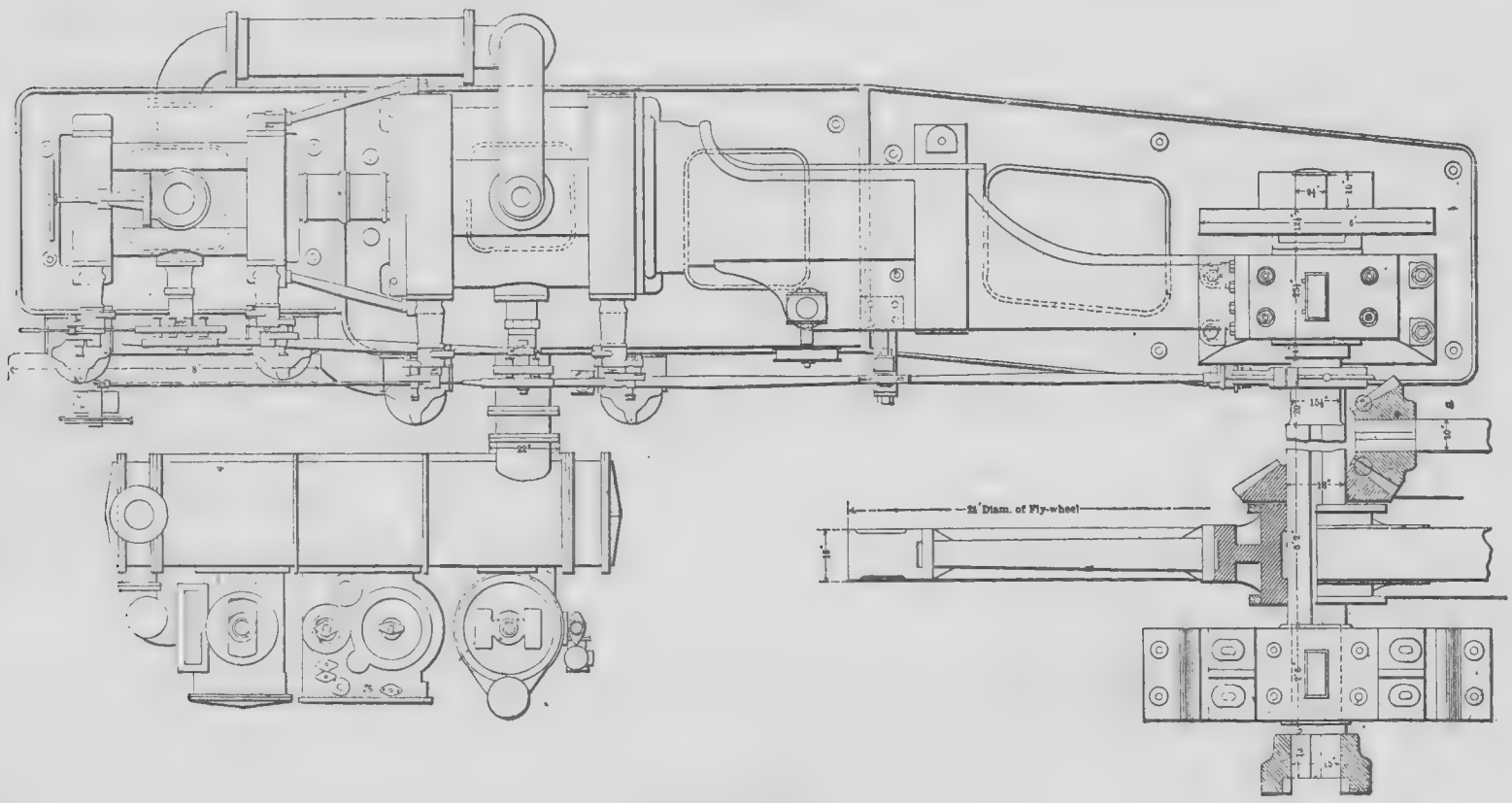
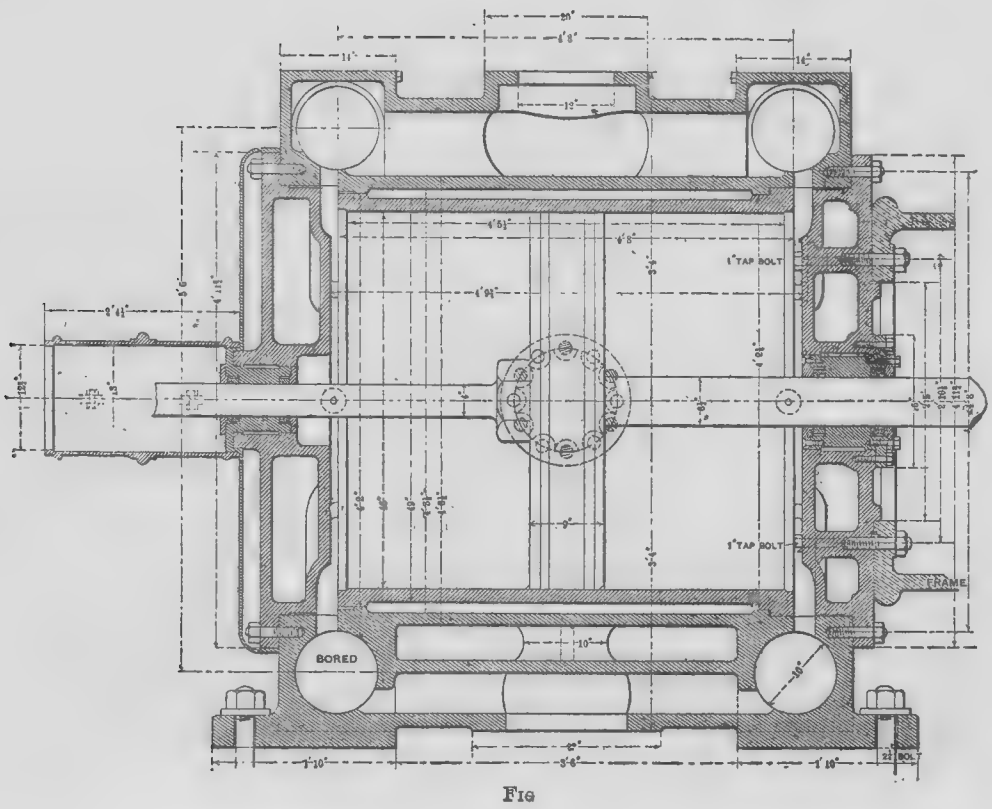


FIG. 2.—PLAN.



FIG

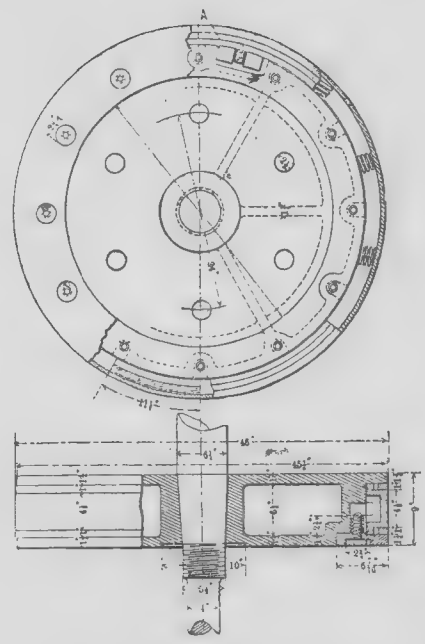


FIG. 5.

Corliss Rolling-mill Engine.

THE illustrations herewith show a compound Corliss engine lately designed for the Pacific Rolling Mill Company, of San Francisco. As the price of fuel in this locality is nearly 30s. per ton, and as the power which this engine is usually required to furnish is about 800H.P., while its extreme running is as high as 1300H.P. to 1400H.P.—it became necessary to build an engine which would do its work with the greatest economy possible, and at the same time be able to furnish the higher power upon demand. With these objects in view it was decided to adopt a compound Corliss condensing engine constructed upon the best modern lines.

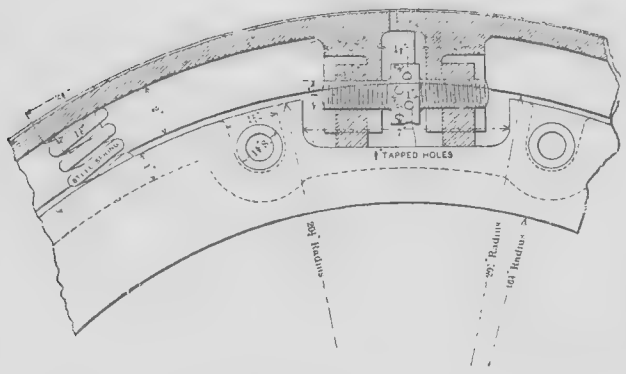


FIG. 4.

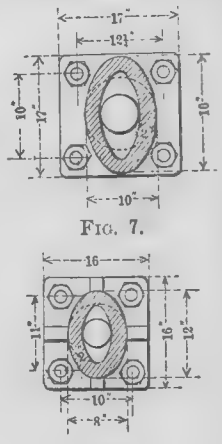
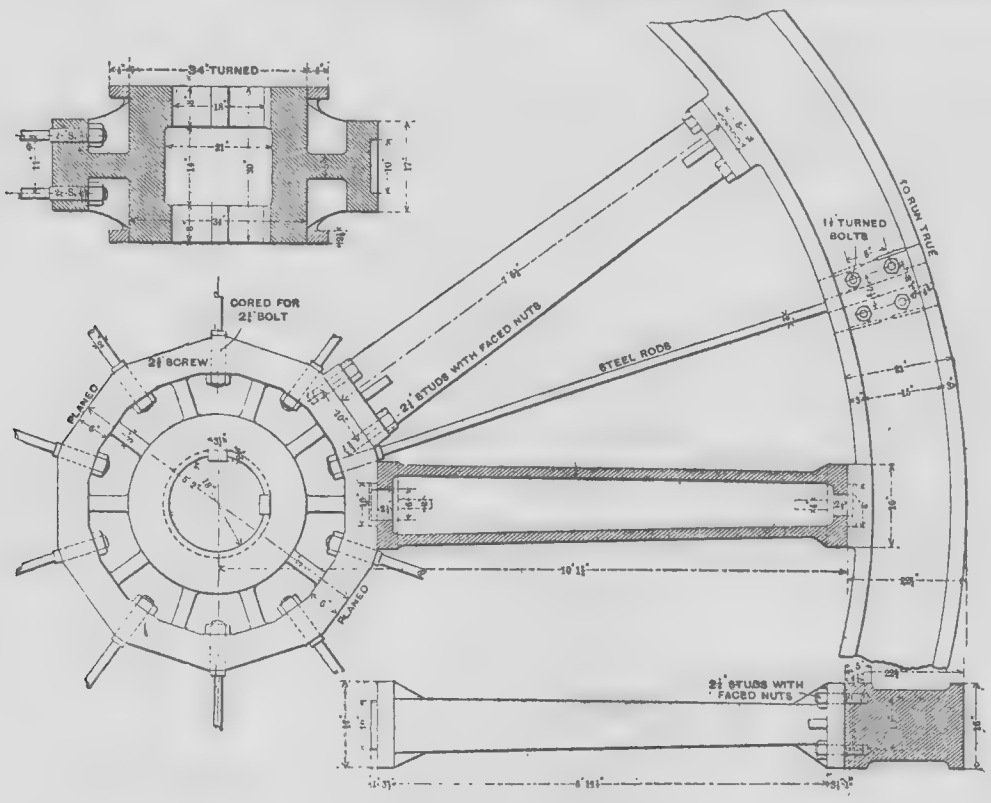


FIG. 8.

The normal steam pressure throughout the mill is 80lb. per sq. in., but provision has been made by which 12 boilers, aggregating about 1500H.P., can be cut off from the main steam system of the mill and the pressure raised to 100lb. per sq. in.; also the high-pressure cylinder can be thrown out of action and the large cylinder used direct in case of need. The pumps, condensers, etc., were all made with this end in view.

The engine is arranged tandem, with the low-pressure cylinder nearest the crank, as shown in the side elevation and plan views Figs. 1 and 2. The high-pressure cylinder has a diameter of 26in., the low-pressure being 46in., and the stroke 48in. Steam from the high-pressure to the low-pressure cylinder passes through a steam-jacketed pipe; both cylinders are also steam-jacketed, and covered with magnesia packing.

The fly-wheel is 24ft. in diameter and weighs 108,000lb. It was turned perfectly true after the parts had been assembled. The centre of the boss is very heavy and the rim of the boss is counter-bored to receive the spokes, which are cast hollow and secured to the rim by studs. In addition to these studs each segment of the rim—of which there are 10—has two steel rods 2in. in diameter with square heads let into the rim and secured to the boss with nuts. The ends of the segments of the rim are faced and bolted together with 1¼in. turned bolts. The details of the construction of the fly-wheel are clearly shown in Figs. 6, 7, and 8, from the "Iron Age." The pistons of both cylinders—that of the low-pressure is shown in Figs. 4 and 5—consist of a cast disc cored out hollow, with a follower of steel. There is a U-ring with two small rings with brass tongue. In the U-ring at each side of the split where the ring is cut there are lugs forming a recess, Fig. 4, to receive brass nuts for a right and left-hand screw intended for drawing together the large ring and making it as tight or as loose a fit as may be required. At the same time, the lugs are free to move together, so that there is no danger of binding when expansion occurs, owing to too tight a fit. The air and circulating pumps are driven from the cross-head of the engine; and the stroke of the pumps, by an ingenious device, can be varied to suit the amount of work the engine is doing, with a provision by which the air pump always "bottoms," no matter how the stroke is varied.



CORLISS ROLLING-MILL ENGINE.—FIG. 6.

Society of Engineers.

THE next ordinary meeting of this society will be held at the Town Hall, Westminster, on Monday, November 7, when a paper will be read on "The Use of Steel Needles in Driving a Tunnel at King's Cross," by Mr. W. H. Holttum, of which the following is a synopsis:—Widening the Great Northern Railway; three tunnels north of King's Cross terminus; introduction of steel bars or needles; economy in excavation; timber bars built in; Jennings' steel driving needles; training the needles; method of driving; prevention of subsidence; concrete ramming behind needles; trussed sills; the independent needle "A"; the interlocking needles "B"; grouping; underpinned works; excavation needed for timber versus steel bars; open cut and cover; crossing Regent's Canal; comparative costs estimated; materials.

Practical Electrical Units.—IV.

OHM'S LAW.

THE last article was closed by the statement that the E.M.F. of a dynamo or battery is generally constant, and we need now only to point out that voltage differs from the fixed E.M.F. by the number of volts required to send the current through the dynamo or battery itself. This is expressed by the equation $E = V + v$, where E = E.M.F. generated; V = voltage spent externally; and v = number of volts spent internally in the generator.

So far we have considered current, resistance, and E.M.F. individually, and without reference to their connection with one another; but as these three fundamental phenomena are always present in an active circuit, we shall now endeavour to give an accurate idea respecting them in a collective sense. The relationship between them, and dependence upon each other, are conveniently expressed as a law which, on account of its importance as the fundamental law of electrical measurements, may be considered in the strictest sense a law of nature. It was discovered and announced by Dr. G. S. Ohm, a German physicist, in 1827, in his "Mathematical Theory of the Galvanic Circuit," and in honour of the great service he thus rendered to the science of electricity it is justly known as Ohm's law.

Before stating the relationship existing between current, resistance, and E.M.F., it will be well to reproduce several fundamental ideas scattered among the previous articles, which will assist materially in grasping what follows.

1. The strength of a constant current in any circuit is uniform in all parts of the circuit.

2. The strength of a current depends upon the connecting wires, because

3. Different materials vary in their conductivity.

4. Difference of potential is the cause of the current or motion of electricity, and determines the E.M.F. of the circuit.

To these we must add that the E.M.F. may be increased by increasing the number of cells in a battery. Now from a consideration of the above ideas it is obvious that for the same conductors the strength of a current entirely depends upon the E.M.F. of the circuit. An increase in the number of cells increases the E.M.F., and therefore the quantity of electricity flowing for any given time through any cross section of the circuit is increased, and *vice versâ*; consequently we say that for the same conductors the ratio of the E.M.F. to the current is a constant, or $\frac{E}{C}$ = a constant quantity, where E = E.M.F., and C = current strength. This constant quantity was discovered by Ohm to be equal in all cases to the total resistance of the circuit; and subsequent experiments having so often verified this, we say that $\frac{E}{C} = R$ expressesin an algebraic form the relationship known as Ohm's law. It is clear that given any two of these three quantities we can, in a simple manner, determine the third, for by transposing one term we get $E = C \times R$, and by a further step we get $C = \frac{E}{R}$. This form is probably the most useful practically, and to those only slightly acquainted with algebraic forms, the following will perhaps be the most serviceable way of remembering Ohm's law—ampèrage $= \frac{\text{voltage}}{\text{ohmage}}$. In this form the word ohmage is used to denote the number of ohms resistance in the circuit.

Expressed in words, Ohm's law is as follows:—The strength of the current varies directly as the E.M.F., and inversely as the total resistance of the circuit.

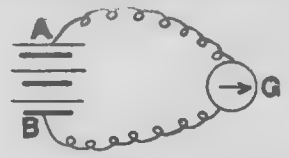


FIG. 3.

Let us illustrate this law and these statements by solving some simple numerical examples:—

Example 1.—A Grove's battery sends a current of 2½ ampères through a circuit. The E.M.F. is 7½ volts; what resistance is there in the circuit?—

$$\text{Since } R = \frac{E}{C},$$

$$\text{then } R = \frac{7\frac{1}{2} \text{ volts}}{2\frac{1}{2} \text{ ampères}} = 3 \text{ ohms.}$$

Example 2.—What pressure (E.M.F.) will be required to send 22 ampères through a resistance of 5 ohms?—

$$\text{Since } E = C \times R,$$

$$\text{then } E = 22 \text{ ampères} \times 5 \text{ ohms} = 110 \text{ volts.}$$

Example 3.—In a 110-volt circuit the total resistance was 11 ohms. What current was produced?—

$$\text{Since } C = \frac{E}{R}, \text{ then } C = \frac{110 \text{ volts}}{11 \text{ ohms}} = 10 \text{ ampères.}$$

Having now explained the relationship that exists between current, resistance, and E.M.F., we are in a position to define the volt in terms of the ampère and ohm. "The standard volt is a pressure such that, if steadily applied to a conductor whose resistance is one ohm, it maintains a current of one ampère."

As a circuit often includes a battery, several connecting wires, measuring instruments, etc., it is clear that they form part of the circuit, and that the resistance of each portion must be included in summing up the resistance of the circuit. Usually we speak of the resistance of the battery as *internal resistance*, and the resistance of the connecting wires outside the battery as *external resistance*. In the circuit represented in Fig. 3, the terminals A and B are connected by a series of conductors—*i.e.*, the wire from A to G with a resistance r_1, the galvanometer with a resistance r_g, and the wire from G to B with a resistance r_2; and in such a simple arrangement each addition increases

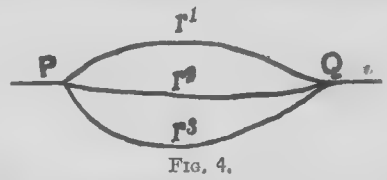


FIG. 4.

the total resistance, and if R_e is the external resistance, then $R_e = r_1 + r_g + r_2$. But the total resistance of the circuit from A through the wires, galvanometer, and battery back again to A, is $R = R_e + R_i = r_1 + r_g + r_2 + r_i$. Conductors arranged in this manner are said to be arranged in *series*, and the total resistance is found by adding together the separate resistances.

In many cases, however, it is necessary in practice to arrange several wires so that their ends are connected immediately to two points, P and Q, as shown in Fig. 4, where three wires (the resistances of which are r_1, r_2, and r_3 ohms respectively) are immediately connected to the two points P and Q. It is obvious that now between P and Q the current has the choice of three paths, and that it divides according to the power of the three separate wires to convey the current—*i.e.*, according to the conductivity of the three wires jointly. With this arrangement the conductivity of the circuit between P and Q is greatly increased, and will equal the sum of the conductivities of the separate portions of this divided circuit. If C equals the total conductivity, and c_1, c_2, and c_3 the individual conductivities respectively, then

$C = c_1 + c_2 + c_3$. But conductivity is the reciprocal of resistance, therefore

$$\frac{1}{R} = \frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3}, \text{ and } R = \frac{1}{\frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3}}.$$

This method of arranging conductors is known as "multiple arc" or "in parallel." We have already seen that when conductors are arranged in "series" the total resistance is increased; but by arranging conductors in "parallel," the conductivity of the conductors is increased, and consequently the resistance of the circuit decreased.

(To be continued.)

Belfast Mechanical and Engineering Association.

THIS association opened their winter session on Friday, the 28th ult., Mr. Geo. Kirk giving the inaugural lecture, the subject chosen being "The Jacquard Machine: Its Uses and Capabilities." There was a good attendance of members and their friends, including John Erskine, Esq., J.P., the honorary president Mr. David Ross, jun., Mr. J. C. G. McFerran, etc.

The chair was taken at eight o'clock by the honorary president, and after the chairman's address (in which he referred to the successful and interesting visits made during the summer), Mr. Kirk proceeded with his paper, and described in detail the method in which plain cloth is woven, as a preliminary to describing the jacquard machines in chronological order from the time of Jacquard to the present day.

By the aid of a large number of drawings the lecturer was able to give a very lucid description of how the beautiful and elaborate designs are woven and portrayed in cloth, pointing out as he went along the improvements that had been made—viz., the draw loom with healds, the addition of the jacquard, the machine as applied to full harness work, the single cylinder double-action, the double cylinder double-action, and Bessbrook machines.

The paper was favourably criticised by Messrs. Erskine, Gamble, and Bell.

The Value of the Steam Jacket.*

THE Research Committee appointed by the Council at the end of 1886 to investigate the Value of the Steam Jacket, presented in October, 1889, their first report, containing tabulated results of previous experiments, obtained from published reports and other sources. Since that time other published results have been obtained, and some members of the committee have carried out experiments. The additional information thus available is contained in this second report.

With regard to the work of the committee themselves, besides collecting what information they could obtain from outside sources, they are now able to present in detail the records of five original sets of experiments, most of which have been specially made for contribution to this report. In each case the experiments were made upon the same engine, both with and without steam in the jackets. The first set of experiments was made by Mr. J. G. Mair-Rumley, on a compound jet-condensing beam pumping engine at Hammersmith; the second by the chairman, Mr. Henry Davey, and Mr. William B. Bryan, on a triple-expansion pumping engine at Waltham Abbey; the third by Lieutenant-Colonel English, Mr. Henry Davey and Mr. Bryan Donkin, jun., on a compound mill engine at the Royal Arsenal, Woolwich; the fourth by Professor W. Cawthorne Unwin, on the experimental engine at the City and Guilds of London Central Institution, South Kensington; and the fifth by Mr. Bryan Donkin, jun., on an experimental vertical engine at Bermondsey.

From a summary of all the experiments which the committee have thus far been able to record or make, it appears that the expenditure of a quantity of steam in an efficient jacket produces a saving of a greater quantity in the cylinder. The ratio between these two quantities is an important factor in this investigation. Unfortunately the jacket water has not been recorded in many of the experiments of which the results have been collected; but in all the experiments made by members of the committee it has been carefully measured and recorded. If q is the percentage saving in feed water—that is, the percentage less feed water resulting from the use of the jackets; p the actual saving in pounds per I.H.P. per hour; and r the water condensed in the jackets in pounds per I.H.P. per hour; then by an expenditure of r in the jackets there is $p+r$ less water passed through the cylinder, p being the credit balance of the account. The following examples are taken from the tables:—

a	q	$p+r$	r	Ratio $p+r$ to r
No.	Per cent.	lb.	lb.	
41	17·4	6·15	3·29	1·9 to 1
42	8·6	2·76	1·20	2·3 to 1
43	10·3	3·50	1·72	2·0 to 1
44	19·0	5·82	1·13	5·2 to 1

No. 44 shows that for every 1·13lb. of steam expended in the jackets, there is 5·82lb. feed water passed through the cylinder, the net saving being thus 4·69lb.

It will be seen from the experiments that generally the smaller the cylinder the greater is the percentage of gain from the use of the jacket, arising doubtless from the fact that a small cylinder gives a larger jacket surface for a given weight of steam passing through it than a larger cylinder does.

In some of the following experiments it was found possible to measure the consumption of coal as well as of feed water, and as these figures have considerable practical value and interest, they are in every case added to the results. Some of the following experiments form, therefore, complete engine and boiler trials, but it must be remembered that the effect of the jackets is measured only by the consumption of feed water, and not of coal.

SUMMARIES OF SEVEN SETS OF EXPERIMENTS ON THE VALUE OF THE STEAM JACKET.

SINGLE-CYLINDER CONDENSING ENGINES.

No. 35.—Record of two experiments on same engine with high-pressure and with low-pressure steam in the jackets.

Single-cylinder Condensing Horizontal Engine.—Cylinder 15in. diameter, 30in. stroke; the body and both ends of the cylinders were jacketed. Experiments made at Messrs. Rivolta's Electric Works, Milan, in February, 1886, by Signor P. Guzzi (College of Engineers and Architects in Milan, 1887).

No experiment was made without steam in the jackets, but in the one case ordinary boiler steam at a pressure of 48lb. per square inch above the atmosphere circulated through the jackets, while in the other steam was supplied to the jackets from a small Perkins boiler at a pressure of 187lb. per square inch above the atmosphere.

Pressure in jackets, lb. per sq. in. above atmosphere.	48lb.	187lb.
Duration of experiment hours	7·2	6·3
Boiler pressure, lb. per sq. in. above atmosphere	56·2	56·6
Revolutions per minute ..	79·0	77·4
Piston speed, feet per minute .....feet	395	387
Results.—I.H.P.	25·3	25·5
Feed water, lb. per I.H.P. per hour, total..	23·85	19·85
Feed water percentage less with high-pressure steam in jackets	—	16·8 p.c.

No. 36.—Record of two experiments on same engine with and without steam in the jackets.

Single-cylinder Condensing Horizontal Corliss Engine. — Cylinder 21·81in. diameter, 49·21in. stroke; the body only was jacketed. Experiments made at Prague, in February, 1888, by Professor Doerfel (Zeitschrift des Vereines Deutscher Ingénieure, 1889). Many other experiments are given in the same paper, showing the economy of the jacket to vary between 7 and 12½ per cent. for about the same cut-off.

Jackets, with or without steam	WITHOUT	WITH
Duration of experiment ..hrs.	6·4	7·3
Cylinder initial pressure, lb. per sq. in. above atmos.....	59·2	62·2
Number of expansions.....	5	5
Revolutions per minute..revs.	56·0	55·7
Piston speed, ft. per min ..ft.	551	548
Results.—I.H.P.	146	159
Jacket water, lb. per I.H.P. per hour .....lb.	—	0·80
Jacket water, in percentage of feed water .....p.c.	—	4·0
Feed water, lb. per I.H.P. per hour, total.....lb.	22·57	19 80
Feed water percentage less with steam in jackets	—	12·3

No. 37.—Record of three experiments on same engine with and without steam in the jackets.

Pair of Single-cylinder Condensing Horizontal Corliss Engines.—Cylinders 25·06in. diameter, 48in. stroke; the body and both ends of each cylinder were jacketed. Experiments made at Messrs. J. and J. Coats's Thread Works, Paisley, in April, 1889, by Mr. Michael Longridge. Steam was supplied to the jackets from the main steam pipe, through ¾in. pipes. (Engine Boiler and Employers' Liability Insurance Co.; Chief Engineer's Report for 1879.)

Jackets in use	NO JACKETS	ENDS ONLY	ALL JACKETS
Duration of experiment .....hours	4	7	7
Boiler pressure, lb. per sq. in. above atmosphere .....lb.	61	61	61
Initial ditto. .....lb.	50	50	5
Number of expansions	4·2	3·9	4·2
Revolutions per min.	65·0	65·0	65·1
Piston speed, ft. per minute .....ft.	520	520	521
Results.—I.H.P.	508	490	488
Jacket water, lb. per I.H.P. per hr.	—	0·18	0·63
Jacket water, in percentage of feed water	—	0·9	3·3
Feed water, lb. per I.H.P. per hour. ..	19·77	19·52	19·27
Feed water, percentage less with steam in jackets..	—	1·3	2·5

(To be continued.)

Metal Trade Memoranda.

Six years ago Belgium exported 8000 tons of iron to India, but last year the exports amounted to nearly 39,000 tons.

M. Mannesmann states that a little tungsten added to pure aluminium obviates all difficulty from attack by water, salt water or otherwise.

The directors of the Aamdal Copper Mines, Norway, owned by a London syndicate, have decided that work shall cease from January 1st next. Some 300 miners are at present employed.

The steel furnaces at the Upper Forest and Morrison Tinplate Works have ceased operations, and all the workmen are thrown out of employment. Upwards of 109 mills in the Welsh tinplate trade are at a standstill.

The Wicker Iron and Steel Works, Sheffield, in the occupation of Messrs. Walker, Eaton and Co., were offered for sale by public auction on the 25th ult. at Sheffield, but, failing to realise the amount expected, the property was withdrawn.

Mr. Vice-Consul Greenfell's latest Foreign Office report on the trade of Uruguay mentions that the northern departments are the actual mining districts, and no doubt, if properly worked and railway communication opened up, are capable of producing good results. Gold, silver, copper, lead, magnesium, and lignite coal exist in certain quantities throughout the districts, and several mines are being worked.

The statistics of American furnaces in blast on October 1 show an increase in the output capacity, after a period of continued decline since March last. The increase appears to have been spread over both the anthracite and coke furnaces, and since September 1 is at the rate of 7500 tons per week, or 32,500 tons per month. The statistics of the stocks of pig iron held in the United States, however, show a decrease of 85,000 tons within the same period.

It is reported from New Orleans that some new and rich gold mines have been discovered in the neighbourhood of Altar, Sonora, Mexico. The mines are owned by Mexican capitalists, who are now employing about 60 men in extracting ore, the poorest of which is said to have shown £40 of gold per ton. One of the miners "has obtained 14,000oz. by a very imperfect process." The great difficulty is lack of water, which has at present to be brought from a considerable distance over a sandy and very tedious road.

The Metal Market.

PRICES CURRENT.

LONDON, October 31.

COPPER has been without any influence of importance, and the tone has ruled extremely dull, buyers and sellers being alike disposed to await the issue of the monthly statistics to-morrow before operating to any extent. A few warrants changed hands at the first session at £46 2s. 6d. three months, and towards the close one warrant of Lota, cash, passed at £45 13s. 9d., final rates being 1s. 3d. to 2s. 6d. lower on the day. Sales, 100 tons. Settlement price, £45 12s. 6d.; English tough, £49 to £49 10s.; best selected, £50 to £50 10s.; strong sheets, £58.

TIN opened in good demand, with cash at £94, which was maintained during early trading, and £94 10s. was paid for three months, £94 15s. for four months, and £94 10s. for Mount Bischoff, cash. Prices hardened later in the day, owing to the reserve of holders and the improvement in the silver market, and an advance of 2s. 6d. was established, cash realising £94 2s. 6d., the market closing firm at 2s. 6d. rise. Sales about 100 tons. Settlement price, £94 2s. 6d.; English ingots, £98. The deliveries from London warehouse during the past month have been 1037 tons, against 1371 tons last month, besides which 490 tons were shipped to America. The stock here is now 3171 tons, inclusive of 1200 tons in course of landing, against 2139 a month ago. Straits shipments over the same period are said to be 3075 tons, but the official return is not expected until to-morrow. Messrs. Strauss and Co. make the visible supply 14,607 tons, against 14,429 tons last month, and 12,435 tons a year ago.

PIG IRON began with one month, Scotch at 41s. 7d. sellers, and 41s. 6d. buyers, and 41s. 4d. was bid for cash, after which business was done irregularly at 41s. 4½d. and 41s 4d. for 2000 tons prompt delivery; but in the afternoon, moving with the Glasgow market, values eased off to 41s. 6d. taken for one month, and the close was quiet at ½d. decline. Sales totalled 2500 tons. Settlement prices:—Scotch, 41s. 2d.; Middlesbrough, 38s.; hematite, 48s.

TINPLATES quiet. I.C. cokes, f.o.b. London, 12s. 9d.; Liverpool, 12s. 3d.; Swansea, 11s. 9d.

LEAD has ruled quiet, and business has been done at £10 5s., a decline of 1s. 3d. for Spanish; English, £10 10s.

SPELTER quiet and unchanged. November shipment, £19, sellers; Silesian special brands, £19 2s. 6d.

ZINC SHEETS.—Silesian steady. Ordinary, £22 2s. 6d., ex-ship here. Belgian firm; V. M. brands, £22 5s., ex-ship London, and £22 f.o.b. Antwerp.

OFFICIAL CLOSING QUOTATIONS.

	£	s.	d.	£	s.	d.
COPPER—						
G. M. B.—Cash	45	12	6	46	0	0
" Three months ..	46	2	6	46	10	0
English tough	—	—	—			
Best selected.....	—	—	—			
Strong sheets.....	—	—	—			
TIN—						
Fine foreign—Cash	94	2	6	94	12	6
" " Three months	94	12	6	95	2	6
Australian—Cash	94	12	6	95	2	6

	s.	d.
PIG IRON—		
Scotch warrants—Cash.....	41	3½
" One month	41	6
Middlesbrough—Cash	Nom.	
" One month.....	—	
Hematite—Cash	Nom.	
" One month.....	—	

GLASGOW, Oct. 31.—The pig iron market was very quiet to-day, and not more than 1000 tons sold, all being Scotch, except 500 tons Cleveland, which sold at 37s. 9d., delivery any time this year. Dealings in Scotch were almost entirely on forward account. Prices were fairly steady, but in the absence of business, latterly eased off and closed ½d. down from Friday's finish. Cleveland and hematite were unchanged for prompt business, but there were offers to sell the former for future delivery at lower prices. The shipments of Scotch last week were 7826 tons, an increase of 2491 tons on the corresponding week of last year, making the increase for the year 28,091 tons.

MIDDLESBROUGH, October 31.—The returns for October of iron and steel shipments are very unsatisfactory, there being considerable decreases; but coastwise pig-iron clearances show an increase of 9551 tons on September. These figures are, however, 7562 tons below October last year. Scotch customers have taken 13,095 tons, being 365 tons below September, and 14,767 below October last year; 10,087 tons of manufacturers' iron, consisting of 4593 for foreign ports and 5494 coastwise, are recorded, being over 3000 below September and between 4000 and 5000 tons below the corresponding month. The shipments of manufactured steel, however, are 16,403 tons, an increase of about 2000 tons. The total shipments are 91,907 tons, and show a decrease of 8000 tons over same period last year.

Official Gazette.

Partnerships Dissolved.

W. CORFE and J. BIBBY, under the style of Thomas Ollis and Co., Liverpool, engineers.

S. LEWIS and J. DAWSON, under the firm of the Enterprise Manufacturing Company, Angler's-lane, Kentish Town, engineers and manufacturers.

T. W. SIDDAWAY and EMMA SIDDAWAY, under the style of E. Siddaway and Sons, West Bromwich, iron founders.

C. T. TINSLEY and L. R. LLOYD, under the style of Eliza Tinsley, Melbourne, Victoria, iron, steel, and general hardware merchants.

THE BANKRUPTCY ACTS, 1883 AND 1890.

Adjudications.

JOHN DERBYSHIRE, the younger, Birdwell, near Barnsley, late of Chesterfield, colliery engineer.

WILLIAM HERBERT HYATT, Harlington, Bedfordshire, chemical and scientific engineer.

EDWARD TEGGIN, Manchester, engineer.

New Companies.

UNITED ELECTRIC TRAMWAYS LIMITED.—This company was registered on the 22nd ult., with a capital of £30,000, divided into 6000 shares of £5 each, with power to increase the same, to construct, purchase, or otherwise acquire, equip, maintain, work, use (by horse, steam, electricity, or other power), any tramway or tramways in the United Kingdom of Great Britain and Ireland, or any foreign country, colony, or dependency, and to carry on the business of tramway, railway, omnibus proprietors, and carriers of passengers, goods, stock, merchandise and minerals, in the said countries or any of them.

PONTHIR TINPLATE COMPANY LIMITED.—This company was registered on the 25th ult., with a capital of £6000, divided into 600 shares of £10 each, to acquire and take over by purchase, conveyance, assignment, assurance, or any other arrangement, the works commonly known as the Ponthir Tinplate Works, situate at Ponthir, in the county of Monmouth; to carry on the business of tinplate manufacturers, makers of terne and other such plates, steel bars, vendors of coal, or any other business which may seem to the company directly or indirectly conducive to any of these objects, and calculated to enhance the value of or render profitable any of the company's rights.

SCHULL COPPER SYNDICATE LIMITED.—This company was registered on the 22nd ult., with a capital of £10,000, divided into 10,000 ordinary shares of £1 each, to adopt and carry into effect, either with or without modification, an agreement proposed to be made between George Baldock and Letitia Thomas, of the one part, and the company of the other part, a draft whereof has, for the purposes of identification, been indorsed with the signatures of the directors and of the subscribers of the company; to purchase or otherwise acquire,

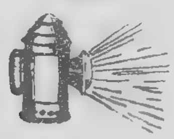
*Abstract of the Second Report of the Research Committee on the Value of the Steam Jacket, to the Institute of Mechanical Engineers, by Mr. Henry Davey, chairman.

improve, manage, work, develop, sell or otherwise deal with mines, mining rights, metalliferous and other lands, milling, smelting, etc., works in Ireland and elsewhere, and generally to carry on the business of a milling and smelting company in all its branches.

Trade Marks.

The following is the Official List of Applications published from October 16 to October 23, for the Registration of Trade Marks, so far as relates to the Metal Trades.

CLASS 5.

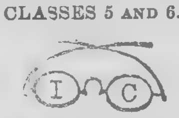


165,326. Unwrought and partly wrought metals used in manufactures—namely: All kinds of iron and steel bars, rods, plates, sheets, and channels, also galvanised iron and steel sheets, and all goods included in Class 5. CATO, MATHER AND CO., The Albany, Old Hall-street, Liverpool; steel and iron merchants.—10th June, 1892.

CLASS 5.

165,770. Unwrought and partly wrought steel used in manufacture. PETER HARKORT AND SOHN, Wetter a/ Ruhr, Germany; steel manufacturers.—4th July, 1892. Mark used since about eight years before the 13th August, 1875. *Address for service in the United Kingdom*, 10, Jeffrey's-square, St. Mary Axe, London, E.C.

CLASSES 5 AND 6.

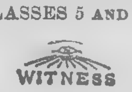


"*The essential particular of the Trade Mark is the device, and we disclaim any right to the exclusive use of the added matter.*"

166,630 — 2329S. Unwrought and partly wrought metals used in manufacture, including iron, steel, and wire JONAS AND COLVER LIMITED, Continental Steel Works, Attercliffe, Sheffield; manufacturers.—20th August, 1892. *By consent.*

166,631—2830S. Machinery of all kinds and parts of machinery (except agricultural and horticultural machines included in Class 7), including machine knives and machine tools. JONAS AND COLVER LIMITED, Continental Steel Works, Attercliffe, Sheffield; manufacturers.—20th August, 1892. *By consent.*

CLASSES 5 AND 6.



166,930 — 2836S. Unwrought and partly wrought metals used in manufacture, including iron and steel. NEEDHAM, VEALL AND TYZACK, Eye Witness Works, Sheffield; manufacturers and merchants.—6th September, 1892.

166,931—2837S. Machinery of all kinds and parts thereof (except agricultural and horticultural machines), including machine knives, machine tools, and similar goods in Class 6 composed wholly or partly of metal. NEEDHAM, VEALL AND TYZACK, Eye Witness Works, Sheffield; manufacturers and merchants.—5th September, 1892.

CLASS 13.

"*The essential particular of the Trade Mark is the following:—The device, and the applicants disclaim any right to the exclusive use of the added matter.*"

164,461. Iron and steel tubes, being goods not included in other Classes. THE UNION TUBE COMPANY, Coatbridge, Lanarkshire; manufacturers.—29th April, 1892.

Letters to the Editor.

**** We do not hold ourselves responsible for opinions expressed by correspondents.*

**** The name and address of the writer (not necessarily for publication) must in all cases accompany letters intended for insertion, or containing queries.*

**** Letters intended for publication in the current week's issue must reach our Manchester Office not later than by the first post on the Tuesday preceding the date of publication.*

THE ARRANGEMENT OF STEAM PIPES.

To the Editor of THE MECHANICAL WORLD.

SIR,—We consider the article on page 172 of your last issue (from "The Locomotive"), entitled "The Arrangement of Steam Pipes," is apt to lead to very serious errors in the arrangement of pipes where there are boilers coupled together.

We enclose a copy of the Board of Trade Explosion Report No. 475, which shows how the opening of a drain tap in a similar position to that recommended in the article was the cause of the explosion the reason for which will be readily understood by you. Now, we recommend that where drain taps are fitted in such a position, they should always be left open, so that water cannot possibly accumulate in the pipes; or better still, coupled to a steam trap, and so prevent any waste of steam which might occur from the plan where the tap is left open. There have been a large number of explosions from the water hammer action generally traceable to an inefficient system of draining the pipes, and we consider this a most important matter.

J. HOPKINSON AND CO.

Huddersfield, Oct. 31.

[WE are exceedingly obliged to Messrs. Hopkinson for their communication, and having in mind their unique experience in steam and boiler fittings of all kinds, we feel sure that their remarks will be duly appreciated by all interested in steam engineering. We may add that the explosion alluded to in the foregoing, refers to an arrangement of steam pipe similar to that shown in Fig. 1 of the article referred to. We append the observations of Mr. T. W. Trail, the Engineer Surveyor-in-Chief to the Board of Trade, in which the matter is summed up very succinctly.—ED. M. W.:—"This explosion appears to have been due to the shock caused by a body of water, lodging in a horizontal pipe—which had been carried forward by the steam from the adjacent boiler—being suddenly arrested by the valve. To attempt to drain a horizontal pipe under the circumstances stated was a dangerous operation, and the result is not surprising. Under such circumstances, when the water gets below the top of the pipe, the steam, brought into contact with a large surface of comparatively cold water, gets condensed, and the steam from the boiler rushing into the empty space carries forward with it the water remaining in the pipe with sufficient force to shatter pipes or connections by which it is suddenly arrested. The arrangement of the pipes was not a good one. Horizontal steam pipes in which water can collect should always be drained before steam is turned on to them. Several fatal explosions have occurred through neglect of this precaution."]

SUGAR-MAKING MACHINERY.

To the Editor of THE MECHANICAL WORLD.

SIR,—Reading in your journal the articles on "Sugar Machinery," I find that 1500lb. per square inch of surface of journal is a usual load on sugar mills, and I should like to know how lubrication is carried out under such a pressure. Any ordinary lubricant would be squeezed out under a much less load. If no lubricant is used, do these journals not heat and abrade the metal? Again, I should like to know, what force applied to the circumference of the roller would work or move such a loaded journal? I understand the surface speed of the roll is not more than 18ft. per minute, and of course the surface speed of the journal would be at most not more than half this—say 9ft. per minute. Still, it appears to me that the journal would be rapidly ground away. The pinion on end of the roller shaft must of necessity be just about the diameter of the roller, and the stress on the teeth of this must be enormous. If the writer of the articles would give an example worked out from some actual case, and state result of the working of the mill, it would no doubt be of interest to many of your readers.

Leith, Oct. 27. R. ELLIOT.

SPEED OF FAN.

To the Editor of THE MECHANICAL WORLD.

SIR,—In your last issue, on page 180, you publish a reply of mine to a query under above heading. It contains a printer's error. I wrote, "Velocity = ^{2}770 (*i.e.*, $\sqrt{770}$)," and not simply 770. Kindly correct to "Velocity = ^{2}770 *times* per second to have the same effect."

G. PINNINGTON, C.E.

Chester, Oct. 31.

RESEARCHES made by Professor Lewis, of the Royal Naval College, more particularly as to marine boilers, respecting boiler incrustation, demonstrates that the burning and collapse of crown plates is often due to the presence of oil or grease in the feed water. Mr. J. B. Edmiston, Liverpool, has devised a filter of flannel and wire cloth to cleanse the feed water previous to injection, and an inspection of one of these filters after use shows their usefulness in stopping impurities. The feed-water filter has already been applied to many boilers.

Miscellaneous Items.

A large costume establishment in Paris is being fitted with electrically-driven sewing machines.

Much attention is being given in Denmark to the subject of narrow-gauge railways in connection with local traffic. It is proposed to construct a railway of this kind from Kolding to Randböl in Jutland.

A giant ferryboat for use on Lake Michigan has recently been launched. The boat is intended to allow carriages to be run on to rails on it, so as to give a long through service by rail and boat. The cost of the steamer is stated at about £50,000.

To waterproof felt for a summer house, melt 1lb. of pitch in half-a-gallon of Stockholm tar. Apply boiling hot, and as the work proceeds strew it freely with dry sand and brush it over with a coarse broom. A little tallow added to above will cause it to flow more freely.

Filling for brass signs and name-plates which will stand exposure to sun, weather and cleaning with acids, is made by melting together two parts each of gutta-percha and asphaltum, and adding one part of shellac. It may be mixed with smalt, vermilion, or other pigment, and should be used hot.

The Postmaster-General is about to receive a deputation of proprietors and others interested in monthly newspapers, etc., who desire to have their publications placed on an equality in regard to postage rates with weekly newspapers. Under present regulations a weekly newspaper weighing up to 1lb. pays only ½d. postage, while the publications referred to have to pay the book rate of postage.

The carbons for electric arc lamps are made by an American inventor with powdered graphite instead of coke, with the object of lessening the rate of consumption. He first compresses the dry powder in a mould of the desired form, and then adds a drying oil, for serving as an agglutinant. It is stated that the resistance may be varied by adding to the graphite finely divided fibre in greater or less quantity.

In connection with the retirement of Sir James Douglas, the builder of the second Eddystone lighthouse, it is of interest to note that Smeaton, the architect of the first, died a hundred years ago on the 29th ult. The stump of Smeaton's structure remains on the site, a few yards from that of the new lighthouse, but the major portion was carefully and with extreme difficulty taken down and re-erected on Plymouth Hoe.

The large steel passenger whaleback steamer which is being built by the American Steel Barge Company for the Chicago World's Fair traffic will be launched, if possible, before the water freezes. She will measure 362ft. over all, and will contain a cabin, extending nearly her whole length, which will be set on turrets, like those on the present whaleback boats, and when completed the vessel will be one of the finest and most costly on the Great Lakes.

Copying paper has lately been prepared in such a manner that there is no necessity to moisten the sheet before taking an impression of the manuscript. This is done by moistening the sheets in a solution of a deliquescent salt, and once prepared in this manner the sheet is always ready for use. A French scientific journal recommends a solution of one-tenth part of chloride of magnesium, or one of one-twentieth part of calcined chloride of lime.

The university of Padua is about to hold a festival in honour of Galileo. December 7, 1892, will be the tercentenary of the day upon which Galileo ascended the chair of mathematics at that university. A letter of invitation has just been issued to some of the learned societies of Europe by the rector, Professor Carolus Ferraris. It is to the honour of Padua that it welcomed Galileo to this high position the very next year after he had been publicly hissed and obliged to resign his professorship at Pisa.

Queries.

☞ Readers are invited to avail themselves of this section for practical information on questions relating to Mechanical Engineering and the Scientific Industries.

☞ Queries and Replies should arrive at the Manchester Office not later than by the first post on the Tuesday preceding the date of publication.

CASTINGS.—Can any reader inform me how to secure clean castings which have wrought-iron pieces "cast in."?—L. U.

CONVERTING GAS ENGINES.—Will any reader kindly inform me how to convert a Crossley's gas engine, 15H.P., slide-valve type, to a tube firing type?—FITTER.

SWEDISH BESSEMER STEEL.—Can any reader inform me how Swedish Bessemer steel is made, and also give highest amount of carbon it contains?—FORGEMAN.

COATING FOR WATER PIPES.—Can any reader tell me how to ascertain whether cast-iron pipes have been properly coated with Dr. Smith's solution?—WATER PIPE.

MOULDING SAND.—Will any reader inform me where the fine moulding sand is obtained which is used for making small malleable-iron castings in Walsall?—IRON FOUNDER.

FLANGING PLATES.—Will any reader kindly let me know which is the best way to flange plates 2ft. 6in. diameter by [illegible] I must flange them by hand, as we have no flanging machine?—BOILER.

HARDENING AND TEMPERING.—Can any reader inform me how to harden and temper a number of straight steel wires 13 gauge and 16in. long? I have tried several ways, but I cannot keep them straight. I may say that I have hardened them in oil, and one at a time.—BLACKSMITH.

LOSSES IN STEEL FURNACES.—Could any reader kindly inform me the average per cent. of actual loss, and the average per cent. of skull, in the charge of a Siemens open-hearth steel furnace working charges of from 30 to 40 tons? And also the percentage of loss in heating slabs and ingots in the Siemens regenerative gas furnace?—J. R. R.

DYNAMO MACHINE.—I have a dynamo of the Gramme pattern of the following dimensions:—Size of armature, 4in. diameter, containing 12 coils ½in. wide by 2in. long; weight of No. 20 wire on field magnets 6lb. (double cotton covered); weight of No. 20 wire on armature 1lb. (double cotton covered). What would be the proper speed to run? What the pressure in volts? And how many ampères? What lamps would be best to use, and how many?—ELECTRICAL ENGINEER.

CASTING SASH WEIGHTS.—Would any reader favour me with information relating to the casting of sash weights in chills. It seems to me that it requires a very expensive plant, and is beset with many difficulties, such as (1) the chill, if made of cast iron and to receive a large number of weights, must be very weighty and cumbersome and not easy of manipulation, therefore incurring great loss of time; (2) the faces require planing and careful adjustment; (3) does not the coreing become awkward? (4) the chill must burn away by constant use; (5) a large quantity of useful metal is lying idle when the chills are not in use. I shall be pleased to receive any information as to a cheaper way of constructing chills, etc.—C. R. ROBERTS.

Replies.

☞ Owing to the constant increase in our correspondence, we regret that we have no alternative but to announce that we cannot reply by post to Queries even when stamped envelopes are sent.

☞ Queries and Replies must in all cases be accompanied by the names and addresses of the writers, as no notice will be taken of anonymous communications.

R. WALLACE.—No address given.

J. FLETCHER.—So far as we can ascertain there are no such firms.

INDICATOR.—You have omitted to give the scale of the diagram.

MAC. DON.—Sweated flanges doubtless refers to soldering, as you suggest.

BRICK MANAGER.—Yes you can heat a chamber by electric heaters, but the cost is much greater than by coal.

NEMO.—See article in our issue for October 21. The plan there given may be modified to suit your requirements if necessary.

H. P. HALL.—We are now unable to give you the date of the journal, but the whole of the article was reproduced in our columns.

ANXIOUS TO KNOW.—The only work we know of likely to suit you is "Engineering Estimates: Costs and Accounts," 12s. 6d. It may be had from our office.

R. J. NUTTALL.—There is no method of calculating such results. Rules which are used for full-sized engines and boilers will not apply to toys.

B. HAWKE.—The experience you have acquired will not be of much service to you. Reed's "Engineer's Handbook," 12s. 6d., may be had from our office.

CYMRO.—A small disc of copper running at a high speed and supplied with emery in the form of a liquid paste is all that is required.

GEORGE OVERHEAD.—The size is equal to the diameter of the tap plus twice the depth of the thread, or, approximately, plus twice the pitch of the thread. In your case the diameter will require to be $2{\cdot}347 + 0{\cdot}18 = 2{\cdot}527$in.

OXONIAN.—In our issue for November 26, 1887, you will find a scale drawing of the hot-air engine, which we imagine is that you refer to. You will be able to obtain full particulars from the article accompanying the illustration.

F. T. E.—An article appeared in our issue for November 1, 1890, which will, we think, give you all the information you ask for.

J. THORNTON (Leeds).—The articles on the "Steam Engine and the Indicator" appeared in the volume from July to December, 1889, and the articles on "Materials of Construction and Machine Design" in the volume from July to December, 1890.

BOILER CORROSION.—One method is to completely fill the boiler with water, closing all openings to prevent any air finding its way into the interior. This plan will answer if the water used is not of a corrosive nature. Another plan is to well dry the interior by introducing fires of coke or charcoal, and placing pans of quicklime in the boiler, all openings being closed to prevent air from entering.

H. C. (London, S.E.)—The final documents or seals of patents are *never* published until about three or four weeks after the opposition stage has expired, which is two months from the date of acceptance of the complete specification. It is a common practice in the profession to hold back the seal of a patent until the agent's account is paid off. The manager of our patents department will always be pleased to assist you.

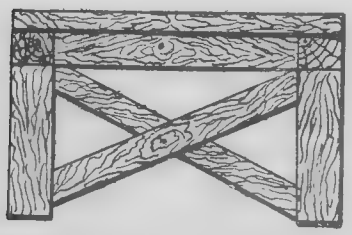
LEVER.—The pressure on the teeth of the segment = [illegible] = 75[illegible]lb., so that we should be inclined [illegible] a pitch of about 3in. The [illegible] hand-wheel = 88in., so that P [illegible] and P = 250 approximately. [illegible] of such gearing is very low, [illegible] more than 0·5. So that P, applied [illegible] the wheel, will be at least 500lb.

HORSESHOE NAIL MAKING MACHINERY.—Required the addresses of firms who are makers of this class of machinery.—*A.*—Mr. Leop. Tolch, of Byrom-street, Liverpool, will give you particulars of such machines.

PEAT COAL.—I shall be very pleased if any reader of your valuable paper can give me some information on the above subject. I am desirous of knowing what firms manufacture it; its properties as a heating agent; what

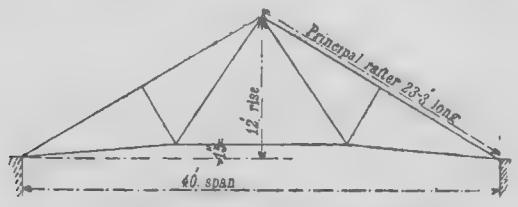
is its heating power in comparison with ordinary good coal; would it be a cheap fuel for firing boilers?—J. W. GEMMEL.——*A.*—A company has been in existence on Dartmoor for some time for the manufacture of the above. The manager is Mr. Wilson, residing near Lidford Station, S.W.Ry., Devon, who will be able to furnish all particulars. For heating power in comparison with ordinary coal see Molesworth, page 459, 1886. Coal gives 5·2lb. to 8lb., and peat 2·5lb. to 4·5lb. water evaporated per pound of fuel.—R. C. MOLLON.

WOOD STAGING.—How are the strains and sizes obtained of the timber platforms as sketched, supposing the framework to be, say, 10ft. square and 8ft. high, supporting a load of 4 tons? Under what conditions does it become necessary to use the diagonals, and



how are the requisite sizes arrived at? What is the best method of connecting? Should the diagonals pass one another, be halved, or one butt against the other?—STAGING.——*A.*—The stress on the horizontal timbers = the distributed load $W = 2 \text{ tons} \times \frac{\text{span}}{8} = \frac{2240 \times 2 \times 120\text{in.}}{8} = 67{,}200\text{in. lb.}$ This must be equated with the moment of resistance of the cross section $\frac{s\,b\,d^2}{5}$, where s = 1000lb. safe strain per sq. in., and b is assumed as 6in. breadth. Then $d^2 = 67{\cdot}2$, and d = say 8in. deep. The posts have to sustain 2 tons each. Let the least breadth be $\frac{1}{16}$ of 8ft. = 6in. The strain should not exceed 500lb. per sq. in. Deduct $\frac{1}{3}$ for tenons, so that the area = 24 sq. in. Hence such a post should be capable of carrying 5 tons. The margin seems large, but 5in. sq. would be insufficient. The diagonal should always be employed, but *bolted* to the sides of the posts near the head and foot. Thus they pass one another and save cutting the posts. The strains in them are indeterminate. Use 7in. × 2in. battens. — FRED WM. QUICK.

ROOF TRUSS.—Required to find the stress on each member of a wrought-iron roof truss, and also the best form of section to be used for each member—*e.g.*, if it was found that the cross sectional area of one of the tie rods was 2in. square, would it be best to use a bar,



say, 4in. by ½in., with the deepest part downwards, in preference to a round bar of equal area? Would it form a more rigid and stronger framework built up of flat bars and analogous sections, such as T-angle, channel, etc., instead of bars of a round section? The weight of each truss I have assumed as 950lb. The load due to corrugated iron covering, etc., is 2lb. to the square foot, and to this I have assumed weight of snow to be 5lb. per square foot, allowing for it being 12in. deep, thus making it, say, 7lb. per square foot. I understand how to construct the diagram according to Clark Maxwell's method (p. 150, Molesworth's Pocket-book); but my chief difficulty is how to place the loads when knowing the weight of the framing and the load when given in so many lb. per square foot.—C. PERCIVAL.——*A.*—The rafters and struts should be of T-iron, and the tension members of round rods. The sizes should admit of good joints. The areas are taken in square inches, and not in "inches square." Flat bars and channel irons are more expensive than T's and rods. Angle irons singly do not make good struts. The wind pressure on this roof appears to have been entirely omitted, and 20lb. per square foot on the slope should be allowed, in addition to other loads. The rafter acts as a beam continuous over one intermediate support. Hence ⅝ the load on one rafter is borne at the strut, and ⅜ at foot and apex. The weight of the truss is in such small work assumed as concentrated at these supported points. The principal rafter should only receive the load at these points, since it acts as a column, and if it be subjected to a bending moment by distributing the load along it, the strains are enormously augmented.—FRED. WM. QUICK.

Latest Inventions.

APPLICATIONS FOR LETTERS PATENT.

When Patents have been "communicated," the name of the communicating party is printed in italics.

Where complete specification accompanies application, an asterisk is suffixed.

17th October, 1892.

18,524 VALVES WHICH CONTROL AUTOMATIC SPRINKLER INSTALLATIONS.* G Mills.
18,529 WATERWAY SMOKEBOX or CHAMBER. S Naylor.
18,531 REMOVING or PREVENTING SCALES in STEAM BOILERS. G P Gardner.
18,533 UNDERGROUND CONDUIT for ELECTRIC CONDUCTORS.* T Wallace.
18,542 BRACKETS for ELECTRIC ARC LAMPS. J K Grindrod.
18,515 CALCULATING MACHINES. M Hearn.
18,563 MACHINES for FORMING, DRAWING, ROLLING, and BENDING METALLIC STRIPS.
18,566 ARRANGEMENT of DIFFERENTIAL PULLEYS, FRICTION, or SPUR WHEELS for GIVING INCREASED SPEEDS WITHOUT UNDUE FRICTION. R E Bradford.
18,569 BELT and ROPE PULLEYS. E Hammesfahr.
18,570 FRAMES for SHAFT SINKING. A Simon.
18,578 MOTIVE POWER ENGINES. T McCarter and T Cooper.
18,581 APPLIANCE for HEATING INCLINED GAS RETORTS. D Terrace.
18,584 BOILERS and FURNACES. W R Renshaw.
18,592 POWER-STORING BRAKE APPARATUS. C Sacco.

18th October, 1892.

18,597 WIRE NAIL-MAKING MACHINES. F Hadley and Co. Limited and T Clarke.
18,598 MANUFACTURE of IRON SULPHATE and MATERIALS for USE in the FILTRATION and PRECIPITATION of SEWAGE. F P Candy.
18,600 JOINTS for ATTACHING METAL PIPES or TUBES to COUPLINGS. W S Dempster and J Crawford.
18,605 BRIQUETTES of FUEL from SMALL COAL, SLACK, COAL-DUST, and COKE-DUST. G Hüttemann and G Spieker.
18,609 CLIMAX SQUARE DRILL. H and W J Jennings.
18,613 ROTATING CUTTER or MILLING MACHINERY. A B Brown.
18,614 WHEELS for CYCLES, PERAMBULATORS, ETC. J Jackson.
18,615 APPARATUS for CHARGING GAS RETORTS. W Fiddes.
18,619 BAND-SAW MACHINES for CUTTING WOOD. T N Robinson.
18,620 SUPPLYING and CHARGING the RESERVOIRS of GAS ENGINES. G E Weyman and G W H Ellis.
18,624 STEAM GENERATORS.* H Goering.
18,629 WIND MOTORS. W J S Barber-Starkey.
18,637 STEAM GENERATORS.* F E Hosmer.
18,638 INTERNALLY-FIRED STEAM BOILERS. E Brook.
18,639 CORRUGATING METAL SHEETS and PLATES. C W Dempsey.
18,642 FRICTION CLUTCHES. S Ford.
18,655 BUILDINGS with MEANS of ACCESS THERETO to SUPPLY them with WATER, GAS, also ELECTRIC LIGHT. H Shaw.
18,659 PERMANENT WAY of RAILWAYS. T E W Fay.
18,667 STAPLE CLOSING or RIVETING MACHINE. A Riekmann. (*H Kleim*, Germany.)
18,674 LIDS of FUEL ECONOMISERS. Sir E Green, Bart.

19th October, 1892.

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20th October, 1892.

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FRIDAY, NOVEMBER 11TH, 1892.

Lighting of Railway Trains.

IF ever the importance of electric lighting for trains was made manifest, it is at the present moment. We do not mean that there has hitherto been no necessity for the introduction of this method of illumination in the carriages—far from it; but the need for the electric lighting of passenger trains is now being very forcibly brought home, and, strange to say, at a time when two companies—the Brighton and the Midland—are reported to have decided to relinquish electrical illumination on the score of expense. We refer to the terrible railway accident to a Scotch express at Thirsk, and where several carriages and persons were burned owing to the train taking fire through some reason or other. The train was lighted by gas, and this, it is assumed, helped to spread the flames and increase the extent of the disaster. However that may be, there is no doubt that in case of a train catching fire, the presence of gas reservoirs on it greatly augments the danger, and where a conflagration occurs under such circumstances there is greater probability of serious consequences. This was shown a few weeks ago when two carriages were destroyed by fire at Clapham Junction, the gas playing a leading part in the burning of the coaches. Here, then, are two instances in which gas has contributed its share towards disaster, and the question arises as to whether its use shall be continued. We think that wherever possible the electric light should be substituted for gas. It is free from the danger inseparable from gas, and as far as our experience goes, and that of most other people, the electric light is far superior to gas illumination for railway carriages. There is no mistaking this fact, and especially on the Midland trains to the North. It seems, however, that the cost of operating these portable installations—or, rather, the cost of producing the light and maintenance—is too high, and that is the reason for the Midland Railway Company's decision to abandon it, whilst the Brighton Company has, we believe, already ceased to run certain trains electrically lighted. That the expense is greater than for gas is beyond doubt; but we think, with such large undertakings as railways, and with the numerous lives daily placed at their mercy, that this matter of expense for lighting should be neglected. A few more railway accidents similar to those at Thirsk and at Clapham Junction will involve the railway companies in considerable expenditure, which would doubtless be reduced by the abandonment of gas for the electric light, and this apart from the compensation for injured and killed. We shall look forward to the time when gas, with its attendant dangers, will be abolished on railway trains and electricity used in its place. The latter will prove the most economical in the long-run, and we would urge upon the engineers of the various companies the advisability of adopting or extending the use of this illuminant both for the comfort and safety of passengers and the welfare of the companies.

Launch of New Battleships.

DURING last week two of the new first-class battleships were launched—the first being H.M.S. "Revenge," which has been built by the Palmer Shipbuilding and Iron Company Limited, Jarrow-on-Tyne, and entered the water on the 3rd inst. The dimensions and particulars of the "Revenge" are as follow:—Length, 380ft.; breadth, 75ft.; draught (mean), 27ft. 6in.; displacement, 14,150 tons; I.H.P. (forced draught), 13,000; I.H.P. (natural draught), 9000; speed (forced draught), 17½ knots; speed (natural draught), 16 knots; and coals carried at the designed load draught, 900 tons. She is built entirely of mild steel, the stem, sternpost, rudder, and shaft brackets being formed of cast steel. The main armament consists of four 67-ton breech-loading guns of 13½ calibres, with a training of 120 degrees on each side of the centre line. The auxiliary armament consists of the following:—10 6in. 100-pounder quick-firing guns, four in armoured casemates on the main deck, and six on the upper deck; 16 6 pounder quick-firing guns, four on upper deck, and 12 on main deck; nine 3-pounder quick-firing guns, three in military tops and six for boats; two 9-pounder field guns; eight 45in. 5-barrelled Nordenfeldt guns; and seven torpedo tubes, four on the broadside, one at the stern, and two submerged. The "Revenge" will be lighted throughout by electricity with an installation of about 700 electric lamps, and will also be equipped with four electric search lights of 25,000 candle-power, each of which will be worked by a dynamo under protection. The "Revenge" is propelled by twin screws, each set of engines having cylinders 40in., 59in., 38in., and a stroke of 51in. There are eight single-ended boilers, each 15ft. 6in. diameter by 9ft. 6in. long, having in all 32 furnaces, and working at 155lb. pressure. There are also no less than 69 auxiliary engines, including:—Steering engine, electric-light engines and dynamos, air-compressing engines, distilling engines, evaporator engines, boat-hoisting engines, and workshop engines. The second vessel, the "Royal Oak," was launched on the 5th inst. from the yard of the builders, Messrs. Laird Brothers, Birkenhead. The vessel is 380ft. long and 75ft. broad, and has a displacement of 14,300 tons. The machinery, made by Messrs. Laird, consists of two sets of triple-expansion three-crank engines with cylinders of 40in., 59in., and 88in. diameter respectively, and 4ft. 3in. stroke, working at 150lb. pressure, and driving twin four-bladed gun-metal screws of 17ft. diameter. The steel boilers are eight in number, single-ended, and each having four corrugated furnaces, the two centre ones with common and the wing ones with separate combustion chambers. They weigh about 36 tons apiece. This machinery is designed to develop 9000I.H.P. with natural and 13,000I.H.P. with forced draught, the estimated speed being in the one case 16 and in the other 17½ knots. The armament will include four 13½in. 67-ton guns of 30 calibres, 10 6in. 6½-ton 100-pounder quick-firing guns of 40 calibres, 16 6-pounder and nine 3-pounder quick-firing guns, eight machine guns, two 9-pounder field guns, and seven torpedo ejectors, of which two are submerged The 6in. casemate armour for the four main-deck 6in. guns has been furnished by Messrs. Vickers, Sons and Co. Limited, of Sheffield. Dynamos are to be fitted to light the ship, by means of 650 incandescent lamps, and to work four search-lights, each of 25,000 candle-power.

Electric Lighting of Markets.

THE formal inauguration took place a week ago to-day of the lighting of the great markets in Smithfield, London, by electricity, the ceremony being performed by the Lady Mayoress, who was accompanied by the Lord Mayor. At present 500 incandescent lamps are in use, although 8000 have already been wired. No less than 100 lamps of 50C.P. are employed in the illumination of the avenues in the four markets, these being supplied free of cost to the Corporation of London. The remaining lamps vary in power from 16C.P. to 50C.P., and are arranged in clusters of three in lanterns. Although not artistic in character—and what could one expect in markets?—the lanterns have been designed and fitted up so as to give the most effective results. An interesting feature in connection with the installation is the fact that the contractors supply electric light at a price which corresponds exactly with that previously paid for gas by the tenants of the market shops. This is an experiment the result of which will be awaited with interest, since the price will amount to about 3½d. per Board of Trade unit. There is, however, one redeeming feature which will assist the contractors—a matter, too, which will have great weight in the result,—and that is the fact that the generating plant will be kept running throughout the 24 hours, and provide a better load for the plant. This will render the prospects of the undertaking brighter.

Test of a Harveyised Armour Plate.

THE reports which reached this country of the results of the tests of a high-carbon Harveyised armour plate carried out by the United States Government were undoubtedly discounted to some extent by our manufacturers of similar material. They evidently accepted the very positive statements from the other side of the water with the proverbial grain of salt, which experience has generally shown to be so necessary in order to duly allow for the high-falutin nature of reports from this source. In this instance, however, we have to confess ourselves altogether mistaken, tests carried out last week at Portsmouth proving altogether beyond doubt the superiority of the Harveyised plate. Contrary to ordinary experience, Palliser projectiles appeared to do as much execution as the French shells, for, although they splashed upon the plate on impact, they made indents of about 1½in. in depth. The Holtzer shells which were used, on the other hand, appeared to weld their points into the target before bursting into a thousand incandescent fragments. Every one was completely pulverised. The most remarkable feature of the trial, however, was the fact that the plate withstood its punishment so well that not a single crack was produced—a quite unprecedented circumstance in armour-plate experiments. It is reported that if further trials with thinner plates prove satisfactory, as there seems no reason to doubt, steps will be taken to replace the thin iron protection with which many of our obsolete armour-clads are fitted, by the American plate, thus greatly increasing their impenetrability.

Hints to British Manufacturers.

PROBABLY a new departure in connection with commercial museums is to be found in that established in Valetta, the principal town of Malta, by Hungary, some months ago. The museum owes its existence mainly to the efforts of the Consul for Austria-Hungary, and its most interesting feature is the fact that articles of Hungarian manufacture and production are not only exhibited, but they are *for sale*—a step which we believe has not been followed out in other countries. The museum is presided over by the right man. He is a merchant by instinct, of commercial education, knows what a community is most likely to require, and proceeds to supply the goods. Moreover, he has the knack of creating wants in the minds of the customers. The source of supply is Buda-Pesth, and the dealers there in goods of different kinds have united to form and stock the Malta museum. Among other, and apart from general, articles exhibited, may be mentioned wire goods, carriages, electrical appliances, hardware, etc. It is understood that the museum has borne good fruit, and this is due entirely to the business-like manner in which the establishment has been conducted, and to the fact that any article on view can be purchased and taken away at the time. British firms would, we think, find it advantageous to bear this important point in mind in the formation or extension of commercial museums. The latter, having samples pure and simple, are of little utility, but with purchasable goods on exhibition, there is ample opportunity for doing a good business.

The Direction of Ocean Currents.

EXPERIMENTS, conducted with a view to ascertain the speed and direction of the currents of the North Atlantic, have been made for some ten years by the Prince of Monaco, who has communicated the results to the French Academy of Sciences. The method adopted by this scientific nobleman is to throw into the sea large bottles encased in a thin copper covering, and containing directions for their return if picked up. Out of 1670 bottles thrown into the sea at different points between the continent of Europe and America, no less than 226 were returned to him by the Governments of the various countries to whose shores they had drifted. Their progress has been noted with sufficient accuracy to lead to the conviction that the movement of the upper part or stratum of the ocean is in a circular direction, the centre being somewhat to the west of the Azores. The tide of the Atlantic thus descends the coast of Africa, and, running towards the west, flows almost to the island of Bermuda; it then turns eastward. The speed at which the bottles travelled is estimated at an average of four miles in twenty-four hours, although at some points a rate of six miles in the same period was attained. The latter speed obtained in the western half of the circle. Several bottles, immersed as long ago as 1886, were exhibited at the Academy, their copper coverings being almost entirely corroded by the action of the salt water. This interesting series of experiments is being continued.

"The Mechanical World Pocket Diary and Year Book."

By referring to our advertisement columns (p. 8) it will be seen that the issue of "The Mechanical World Pocket Diary and Year Book" for 1893 is now ready. The work has again been considerably enlarged, while a number of new tables, notes, and memoranda have been included, which it is thought will still further enhance its value as a pocket companion for managers, draughtsmen, engineers, and mechanics. With this object in view, we have endeavoured to condense a large amount of useful information into a small compass, and have carefully avoided the introduction of historical dissertations and descriptions and illustrations of obsolete instruments and apparatus. We would advise all who wish to possess a copy of this work to order at once of their newsagents, as there is already every indication of our first edition of 15,000 copies being rapidly sold out.

Society of Engineers.

At a meeting of the Society of Engineers, held at the Town Hall, Westminster, on Monday, 7th November, 1892, Mr. Joseph William Wilson, jun., president, in the chair, a paper was read by Mr. W. H. Holttum on "The Use of Steel Needles in Driving a Tunnel at King's Cross."

The author alluded to the advantages derived in working the traffic to and from the London terminus of the Great Northern Railway, in consequence of the execution of an additional tunnel, with approaches, opened this year for goods and passenger traffic.

The new tunnel is on the western side of the two older tunnels, the first of which was built in 1850. In length each is 527⅓ yards, the inverts throughout resting on the solid blue clay of the "London clay" formation. The two newer tunnels have a clear width of 26ft., or 1ft. more than the original central tunnel. Similar conditions obtain for the three tunnels, and they pass, in a northerly direction, level beneath the Regent's Canal, which is supported upon cast-iron crown plates carrying the clay puddled bed of the canal; thence the rail gradients rise 1 in 371 and 1 in 75 up to the north faces. In the recently-completed tunnel an opportunity presented itself for the introduction of a novel method for working out the excavation beneath steel bars, or needles, having a thickness of only 2in., in place of the ordinary timbering, which generally requires 18in. excess of excavation around the extrados in order to build the arch of the tunnel. The first needles used were those patented by Messrs. Jennings and Stannard. The author described the form and method of driving these needles by means of screwjacks; also the various contrivances used to fill up the 2in. annular space left over the tunnel when the forward movement of the needles began, and the plan ultimately adopted of running fine cement concrete along chases, left at intervals within the outer ring of the tunnel arch, whereby the chase, as well as the space behind the advancing needles, became filled with an imperishable material, and the subsidence of the surface of the ground was reduced to a minimum not worth any serious consideration, although beneath the busy goods yard traffic, which uninterruptedly continued during the construction of the tunnel.

Reference was made to the use of trussed cills, instead of the usual long rakers, to the upper cills of the face timbering, which had the advantage of leaving the temporary roads of the tunnel less obstructed, as well as having no raker holes in the invert to fill up afterwards. Another introduction, designed by Mr. E. Duncan, to obviate a tendency the needle had at times to drop out of place, was that of interlocking the needles so as to form an almost solid steel roofing of 2in. in thickness. These were worked northwards from Nos. 1 and 2 shafts, whilst the earlier needles did duty southwards from Nos. 2 and 3 shafts, in lengths averaging 6ft.

Where underpinned piers interposed within the area of the proposed tunnel and prevented further driving, the steel needles were removed and timber bars were resorted to and built in as the work proceeded.

In conclusion, the author referred to the evident economy of this new method of driving tunnels, or culverts; and he considered that engineers would find, among the various conditions under which tunnelling was to be executed, that this new method has a large sphere of usefulness in effecting both economy and good workmanship.

The engineer for the King's Cross tunnel works was Mr. Richard Johnson, M. Inst. C.E., and the contractor was Mr. Henry Lovatt.

Sugar-making Machinery.

XXII.

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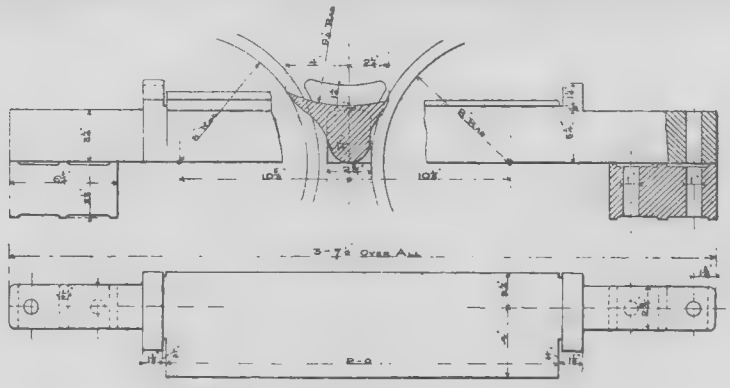
Dumb Returners.—In order to guide and advance the partly-crushed canes which have passed the front roller, to the back roller for the final squeeze between the back and top rollers, a "dumb returner,"



Sugar-making Machinery.—Fig. 42.

or "trash turner," as it is sometimes called, is placed under and between the two lower rollers. The upper surface is curved nearly concentric with the upper roller, the space between being sufficient for the passage of the semi-crushed canes. Formerly, it was common for mills to be fitted with returner bars much too light. As long as "choking" does not take place, no trouble will be experienced. But should a cane double up, and cause "choking" of the mill, trouble begins. The rolling friction of rolls is not a serious matter, but the sliding friction in the confined space between the top roll, the front roll and the returner bar, and the back roll, is very great. If the canes choke between the rolls, the action becomes that of a powerful brake through which the whole force of the engine is exerted, multiplied by the ratio of the intermediate gearing. If the returner bar is weak, it bends, and the jam is relieved. The bar has then to be taken out and straightened, if of wrought iron, and work resumed.

In the smaller sizes of mills the returner bars are of cast iron passed through the "cheeks" or "headstocks" of the mill, and resting in an opening cast in them.

Fig. 42 shows the dumb returner for a small mill having rollers 16in. diameter by 24in. long. The bar is square in section and curved on the face to a radius struck from the centre of the top roll, the front edge being set close up to the front roller, a small space being left between the back of it and the back roller for the escape of the juice. The bar, it will be seen, rests on two loose blocks carried in the openings in the headstocks, and bolted to a snug on the outside of headstock, which is provided with a slot hole for adjustment. A flange is cast on at each end to prevent the escape of the crushed canes past the ends of the rolls.

Fig. 43 shows a cross section and part plan of a returner bar for a large mill having rollers 36in. diameter. It is formed of a solid wrought-iron bar 10in. deep by 7½in. wide, faced with a 1¼in. steel plate fixed with screws to the bar and curved. The front edge is bevelled to a point which is set close up to the cane roll. The front edge is serrated with a series of semi-circular notches, 1in. wide and ⅜in. deep, to allow the juice to fall through. The steel faceplate is strengthened by a wrought-iron plate riveted to underside of plate and close up to bar. At the ends are fixed pieces of angle irons to form flanges to prevent the escape of the crushed canes. The square bar rests in the openings cored out of the side of the headstock, and is fixed in position by blocks and wedges. The bars we have illustrated so far have to be adjusted when required to suit the position of the front roller when crushing.

In mills of more modern design, the dumb returners are made somewhat differently, and are arranged to automatically adjust themselves to the movements of the front or cane roller.

Figs. 44 and 45 show a good example of this form of trash turner. The bar, it will be seen, is "girder"-shaped and very deep, so as to be as stiff as possible. It is made of cast iron and fitted in closely between the two bottom rolls. Its ends rest on blocks bolted to brackets cast on inside of headstock. The blocks have projecting bosses, round which a wrought-iron strap is bolted to prevent any lifting up of the bar. The top of the bar is curved to a radius struck from near the centre of the top roll, so formed as to leave the space at megass side of roll wider than it is at cane side. On the top face of the bar is let in a wrought-iron or steel plate, secured by countersunk bolts. The bar, it will be seen, is able to rock on the blocks referred to. The edge of the steel scraping plate is kept up to the cane rollers by means of the hook bolts placed at each end of the rollers. The hook end of the bolt engages with a recess cast in the back of the top flange of bar as shown. The body of the bolt is made rectangular, and is bent to pass over cane roller gudgeon, the screwed end passing through two flat wrought-iron bars fastened to brackets cast on cane-roller covers, and secured by lock nuts. In this way the scraper of the trash turner is kept constantly up to the cane roller, no matter how it may vary its position through irregular feeding. Sometimes the screwed ends of the bolts pass through a projecting boss cast on the inside of cane-roller cover. This form of trash turner is very neat, and cannot well be surpassed for its purpose.

The one illustrated is for a mill having rollers 34in. diameter by 78in. long; the main dimensions being given on the figures. The distance between the face of the bar and the top roller varies from 1¼in. to 3in.

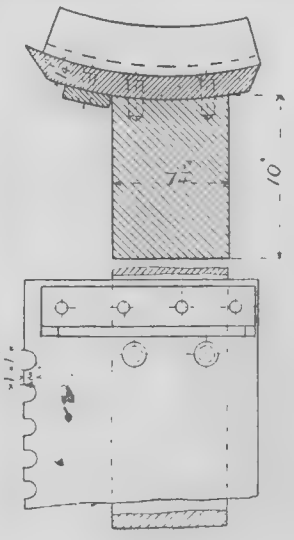
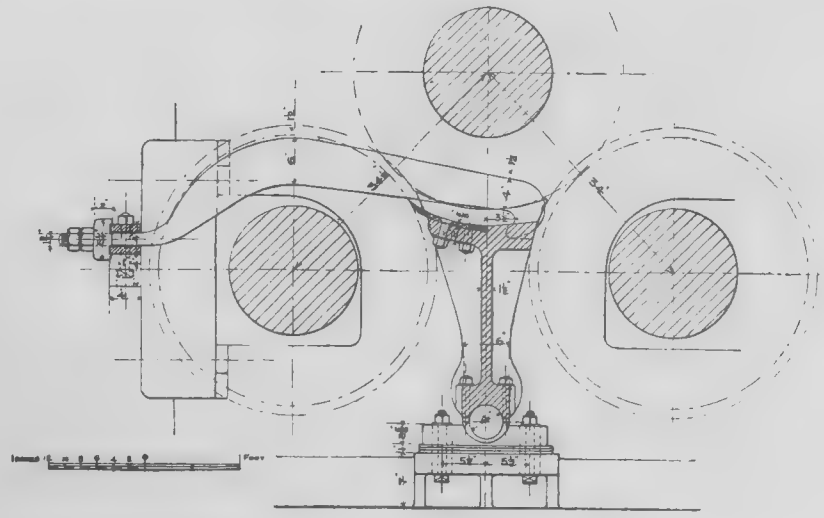
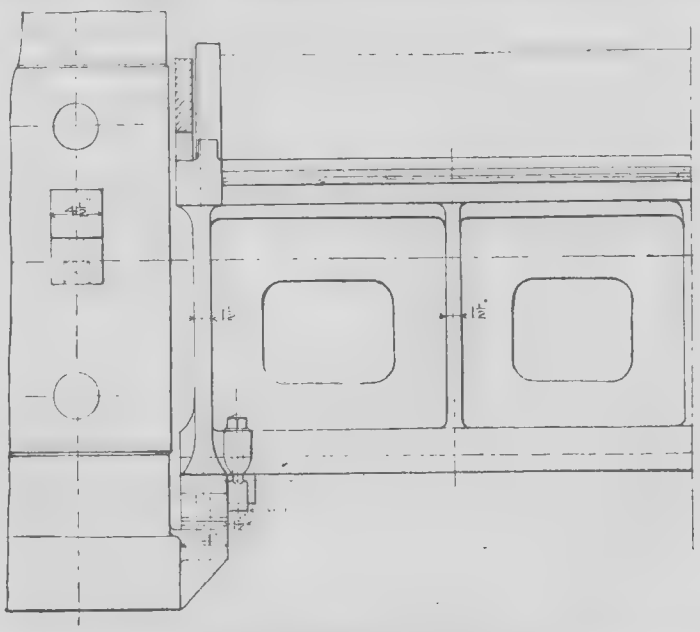


Fig. 43.



Sugar-making Machinery. Fig. 44.



Sugar-making Machinery.—Fig. 45.

(*To be continued.*)

Newcastle-on-Tyne Engineering Students' Club.

A meeting of the above club was held at the Durham College of Science on Tuesday evening, November 1, when Mr. E. Towers, jun., read a paper on "Hydraulics." The chair was occupied by Mr. E. Towers, sen. Commencing his paper with the early application of water-power to machinery, as in the Trompe-blower and Bramah press, and after treating generally on hydrostatics, Mr. Towers went into a detailed description of hydraulic machinery in connection with docks. Starting with the accumulator, the lecturer treated very fully the different designs and arrangements of engines, pumps, cranes, hoists, etc., illustrating the same by numerous lantern slides and diagrams. An interesting discussion followed, and the usual votes of thanks to the reader of the paper and the chairman terminated the proceedings.

To make paper waterproof, take 24oz. of alum and 4oz. of white soap, and dissolve in 2lb. of water and 2oz. of gum arabic; then dissolve 6oz. of ordinary glue in 2lb. of water and when all the articles are thoroughly dissolved mix all the ingredients together into a vessel. To prepare the paper, make the solution warm and dip the sheets of paper into it, and then hang them so prepared on a line, and leave to dry.

The Design and Construction of Stationary Engines.—XL.

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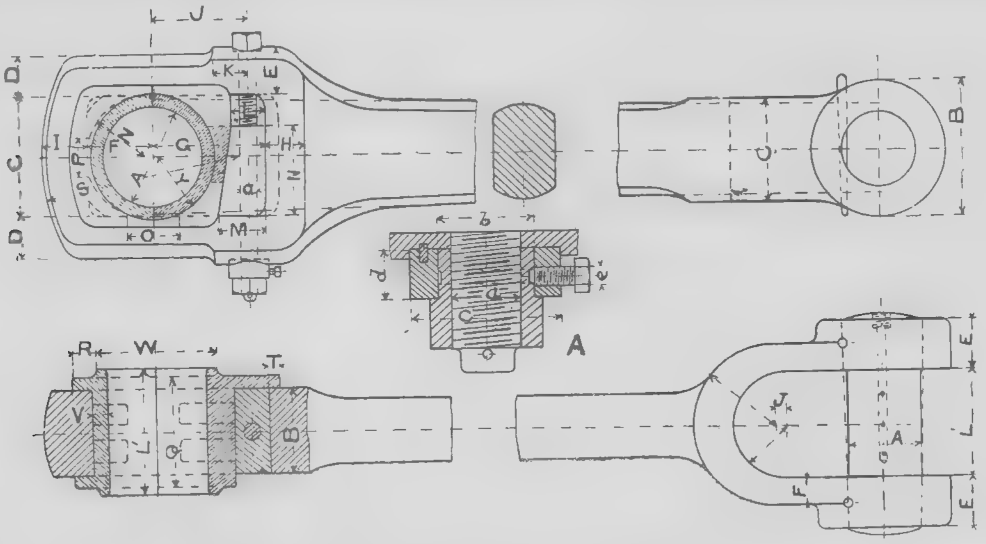
Fig. 187 shows a solid-ended rod of rectangular section similar to Fig. 176. The rectangular shape gives the strongest section for the least weight for high speeds.

The bearing for the crank pin is made of gun metal, and the back half is adjusted by means of the wedge block and a Penn's safety screw. The crosshead end of this rod is also of the forked type, but the pin is made somewhat differently. The bearings of the pin in the fork are parts of a continuous cone, and they are fixed by means of tapered pins passing through, as shown.

The lubrication of the crosshead pin is effected through the centre, a hole being bored up from one end to near the end of the bearings, and then two holes drilled through to it from the circumference, the lubricant thus passing from the centre to the outside.



Design and Construction of Stationary Engines.—Fig. 187.

TABLE XXVI.—DIMENSIONS OF WEDGE BLOCK BOLT AND NUT.

a	b	c	d	e
in.	in.	in.	in.	in.
5/8	15/16	1 9/16	7/8	1/4
3/4	1 1/16	1 3/4	7/8	1/4
7/8	1 1/4	2	1	1/4
1	1 7/16	2 3/16	1	5/16
1 1/8	1 9/16	2 3/8	1 3/16	5/16
1 1/4	1 3/4	2 9/16	1 3/16	3/8
1 3/8	1 7/8	2 3/4	1 3/16	3/8
1 1/2	2	2 15/16	1 3/8	7/16
1 5/8	2 3/16	3 1/8	1 3/8	7/16

The lubrication of the crank pin is generally done by means of lubricators screwed into or fixed on the end of the connecting rod; but this point will be more fully considered when dealing with crank pins.

TABLE XXV.—DIMENSIONS OF CONNECTING ROD ENDS—CRANK PIN END.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	a
2 3/4	2 3/16	3 7/16	1 1/16	1 7/16	1 13/16	3 7/16	1 1/16	1 7/16	2 13/16	1 3/8	1 3/16	1 1/2	2 5/8	1 3/16	1 3/4	3 3/8	5/8	5 1/4	1/4	1/2	3/8	3 9/16	3/16	1/4	1 3/4	5/8
2 13/16	2 3/4	3 11/16	1 3/16	1 1/2	2 1/16	3 11/16	1 3/16	1 1/2	3	1 3/8	1 1/4	1 5/8	2 3/4	1 1/4	1 1/4	3 [illegible]	5/8	5 5/8	1/4	1/2	3/8	3 3/4	1/4	5/16	1 7/8	5/8
3 5/32	2 3/4	3 15/16	1 1/4	1 5/8	2 3/16	3 15/16	1 1/4	1 9/16	3 1/8	1 3/8	1 5/16	1 11/16	3	1 3/4	1 15/16	3 3/4	11/16	6 13/32	5/16	1/2	3/8	4 1/8	1/4	5/16	1 15/16	3/4
3 3/8	2 15/16	4 3/16	1 3/8	1 3/4	2 1/4	4 1/8	1 3/8	1 21/32	3 5/16	1 1/2	1 3/8	1 3/4	3 1/8	1 3/4	1 15/16	3 15/16	11/16	6 3/4	5/16	1/2	3/8	4 3/8	1/4	5/16	2 1/16	3/4
3 9/16	3 5/32	4 1/2	1 7/16	1 13/16	2 7/16	4 5/16	1 7/16	1 3/4	3 9/16	1 1/2	1 7/16	1 7/8	3 5/16	1 13/16	2 3/16	4 1/8	3/4	7 1/8	3/8	5/8	1/2	4 1/2	1/4	3/8	2 1/4	3/4
3 3/4	3 3/8	4 3/4	1 1/2	1 7/8	2 9/16	4 1/2	1 1/2	1 13/16	3 3/4	1 9/16	1 7/16	2	3 1/2	1 15/16	2 3/16	4 3/8	3/4	7 1/2	3/8	5/8	1/2	4 3/4	1/4	3/8	2 3/8	3/4
3 15/16	3 9/16	4 15/16	1 9/16	2	2 11/16	4 3/4	1 9/16	1 7/8	3 15/16	1 9/16	1 1/2	2 1/16	3 5/8	2 1/8	2 3/8	4 1/2	7/8	7 7/8	3/8	5/8	1/2	4 15/16	1/4	3/8	2 1/2	7/8
4 1/8	3 3/4	5 3/16	1 21/32	2 1/16	2 13/16	4 15/16	1 21/32	2	4 1/8	1 9/16	1 9/16	2 1/8	3 3/4	2 1/8	2 3/8	4 3/4	7/8	8 1/4	3/8	5/8	1/2	5 5/16	1/4	3/8	2 5/8	7/8
4 5/16	3 13/16	5 7/16	1 3/4	2 1/8	2 15/16	5 1/8	1 3/4	2 1/16	4 1/4	1 3/4	1 11/16	2 3/16	3 15/16	2 3/8	2 9/16	4 15/16	7/8	8 5/8	1/2	11/16	1/2	5 1/2	1/4	7/16	2 3/4	7/8
4 1/2	3 15/16	5 5/8	1 13/16	2 1/4	3 1/16	5 5/16	1 13/16	2 1/8	4 3/8	1 3/4	1 11/16	2 1/4	4 3/32	2 3/8	2 9/16	5 1/8	1	9	1/2	11/16	1/2	5 11/16	5/16	7/16	2 13/16	7/8
4 3/4	4 1/8	5 15/16	1 7/8	2 1/4	3 1/4	5 1/2	1 7/8	2 3/16	4 5/8	1 3/4	1 3/4	2 3/8	4 1/4	2 3/16	2 3/4	5 5/16	1	9 1/2	1/2	11/16	5/8	5 7/8	5/16	1/2	2 15/16	1
4 15/16	4 5/16	6 1/4	1 15/16	2 3/8	3 7/16	5 11/16	1 15/16	2 5/16	4 3/4	1 3/4	1 13/16	2 7/16	4 3/8	2 9/16	2 3/4	5 1/2	1	9 7/8	1/2	11/16	5/8	6 1/8	5/16	1/2	3 1/8	1
5 1/4	4 1/2	6 1/2	2 1/16	2 7/16	3 1/2	5 15/16	2 1/16	2 3/8	4 15/16	2	1 7/8	2 1/2	4 5/8	2 3/4	3	5 3/4	1 1/16	10 1/4	5/8	11/16	5/8	6 1/2	5/16	1/2	3 1/4	1
5 1/2	4 3/4	6 7/8	2 3/16	2 9/16	3 11/16	6 1/4	2 3/16	2 9/16	5 5/16	2	2	2 11/16	5	2 13/16	3 1/8	6 1/8	1 1/16	11	5/8	3/4	5/8	6 7/8	3/8	1/2	3 7/16	1
5 13/16	5 1/8	7 3/8	2 1/4	2 3/4	3 15/16	6 11/16	2 3/8	2 3/4	5 11/16	2 3/16	2 1/8	2 13/16	5 5/16	3 1/8	3 5/16	6 1/2	1 3/16	11 7/8	5/8	3/4	5/8	7 1/2	3/8	9/16	3 11/16	1 1/8
6 1/4	5 1/2	7 7/8	2 7/16	2 15/16	4 1/8	7 1/4	2 1/2	3	6 1/8	2 3/8	2 1/4	3	5 11/16	3 5/16	3 3/4	6 7/8	1 3/16	12 1/2	11/16	7/8	11/16	7 7/8	3/8	9/16	3 15/16	1 1/8
6 11/16	5 13/16	8 1/4	2 9/16	3 1/8	4 3/8	7 11/16	2 11/16	3 1/8	6 1/2	2 3/8	2 3/8	3 5/32	6 1/8	3 9/16	3 15/16	7 1/4	1 1/4	13 5/8	11/16	7/8	11/16	8 1/2	3/8	9/16	4 1/8	1 1/8
7 1/16	6 1/8	8 13/16	2 11/16	3 5/16	4 5/8	8 1/16	2 7/8	3 3/8	6 3/4	2 5/16	2 1/2	3 5/16	6 3/8	3 3/4	4 1/8	7 11/16	1 1/4	14 1/8	11/16	7/8	11/16	8 7/8	7/16	5/8	4 3/8	1 1/4
7 1/2	6 1/2	9 1/4	2 13/16	3 7/16	4 7/8	8 1/2	3	3 9/16	7 1/16	2 9/16	2 5/8	3 1/2	6 11/16	3 15/16	4 5/16	8 1/16	1 3/8	15	3/4	1	11/16	9 7/16	7/16	5/8	4 5/8	1 1/4
7 7/8	6 7/8	9 3/4	2 15/16	3 5/8	5 1/8	8 7/8	3 5/32	3 3/4	7 1/2	2 3/4	2 3/4	3 11/16	7 1/16	4 1/8	4 1/2	8 11/16	1 3/8	15 3/4	3/4	1	11/16	9 7/8	1/2	11/16	4 7/8	1 1/4
8 1/4	7 1/4	10 1/4	3 1/16	3 3/4	5 7/16	9 1/4	3 5/16	3 15/16	7 3/4	2 3/4	2 7/8	3 13/16	7 1/2	4 5/16	4 3/4	9 1/16	1 7/16	16 3/4	3/4	1	3/4	10 1/4	1/2	11/16	5 1/8	1 3/8
8 13/16	7 1/2	10 11/16	3 1/4	3 15/16	5 11/16	9 5/8	3 1/2	4 1/8	8 1/16	2 15/16	2 15/16	3 15/16	7 3/4	4 1/2	4 15/16	9 7/16	1 9/16	17 3/4	7/8	1 1/8	3/4	10 11/16	1/2	3/4	5 3/8	1 1/2
9 1/16	7 7/8	11 3/16	3 3/8	4 1/8	5 7/8	10	3 5/8	4 5/16	8 7/16	3 1/8	3 1/16	4 1/8	8 1/16	4 3/4	5 1/8	9 7/8	1 9/16	18 11/16	7/8	1 1/8	3/4	11 1/4	1/2	3/4	5 5/8	1 1/2
9 7/16	8 1/4	11 5/8	3 7/16	4 5/16	6 1/8	10 5/8	3 3/4	4 1/2	8 7/8	3 3/8	3 1/8	4 3/8	8 7/16	4 15/16	5 5/16	10 1/4	1 3/4	19 11/16	7/8	1 1/8	3/4	11 13/16	9/16	3/4	5 15/16	1 5/8

Table XXV. gives a number of leading dimensions for the crankpin ends of this type of rod, while Table XXVI. gives the dimensions of the wedge block and bolt, an enlarged view of which is shown at A, Fig. 187.

(*To be continued.*)

On the 5th inst., there was launched from the yard of the Tyne Iron Shipbuilding Company Limited, of Willington Quay-on-Tyne, a steel screw steamer. The dimensions are:—Length, 248ft.; breadth, 34ft.; depth, 23ft. 4in. moulded. The engines, which are to be supplied by Messrs. Wigham Richardson and Co., of the Neptune Works, Newcastle, are of the triple-expansion type, of large power, to drive the vessel 10 knots per hour at sea.

Friction.

Friction is said to be the unrelenting foe to all motion, also that man may construct the most skilful of mechanical devices hung or poised upon the most delicate centres, yet they will remain in a perfect state of rest unless some force is applied to move them, and as soon as that propelling power ceases the motion will begin to decrease, and continue to do so until it arrives at a state of rest.

Now, while it is true that the natural laws of friction are opposed to motion, yet there are other forces which combine with friction to produce that result that are apt to be overlooked, and many of the faults that are charged against friction are attributable to inertia, atmospheric resistance, etc. Notwithstanding all that has been said against friction, it is a necessary element in mechanics, and many of the most important mechanical operations and movements could not be performed without it. Therefore, while friction may be opposed to motion, in the broad sense of the term, still that opposition often becomes a necessary element; and while in some cases it may be desirable to dispense with it as far as possible, in others means are devised to increase that opposition, and the best results are often obtained by that increase.

In the transmission of power by belting it is desirable to obtain the greatest amount of friction between the face of the pulley and the belt. This may be accomplished by three different methods: First, by the use of large pulleys and wide belts; second, by increasing the tension and speed of the belt; and, third, by the use of compounds that increase the adhesion to the pulley, and thereby increase its friction or driving power; and with these three different methods, each of which may accomplish the same result, it is a question to be considered which is the most practical and economical in the end, or, in other words, where a certain amount of friction is required the question is reversed, and instead of "anything to beat friction" being the motto, it is anything to increase it.

Now in the case of small pulleys and narrow belts, in order to obtain an increase in friction or driving power, high speed and tight belts become necessary; or if the conditions are such that the speed cannot be increased beyond a certain limit, then the tension must be increased in the same proportion, or some compound used to increase its adhesion to the pulley, and frequently both. The first, as is well known, is destructive to the belt by straining it beyond its powers of endurance, besides the extra wear upon the journals and boxes, while the use of compounds sold under the name of belt dressings is equally destructive to the belts by rotting them, and in either case the belt soon becomes worthless. Therefore, it should be the study of the designers of all machinery driven by belts to obtain the greatest amount of friction with the least tension upon the belts that drive it, and this can only be obtained by the use of large pulleys and wide belts running at a moderately high speed. There is a manifest error in classing all cases of friction under the same head, and claiming that belt friction is in all cases governed by the same laws as the friction upon the boxes and journals of a running shaft.

Now, without entering into a discussion as to whether the unit of friction in a running shaft is naturally increased by the speed thereof, the surface and weight being the same, still we do know that the power of a belt running over two pulleys at a certain speed, and with the same tension, is increased or decreased directly in proportion to the speed.

Aside from the use of friction as applied to belts and pulleys, there is another method by which friction becomes a useful element in propelling machinery. In many cases where certain parts of machines require to be stopped suddenly, the use of friction wheels has been found preferable to either a belt or gearing, and for this purpose two wheels, smooth upon the face, are so arranged that they may be suddenly brought in contact with each other or released at the will of the operator, and with such devices friction becomes an important and useful element. Such wheels should both be composed of the same kind of material, as it is well known that the friction between the surface of similar metals is greater than that of dissimilar ones, and those materials which are susceptible of the greatest amount of friction should always be used, and wrought iron is probably the best for this purpose. The brakes used upon machinery for stopping the motion, as well as those which are applied to the wheels of a train of cars, give another practical illustration of the advantages derived from friction, as in no other practical manner could the speed of a train be arrested with equal safety.

While the various tests made by the most scientific engineers in this country, as well as in France and England, have established the fact that friction, when two bodies are pressed together with equal force, is independent of the velocity with which they are moved—that is to say, that the unit of friction is no greater with two sliding bodies in intimate contact and pressed together with the same force and moving at the rate of 200ft. per minute than it would be at 100.

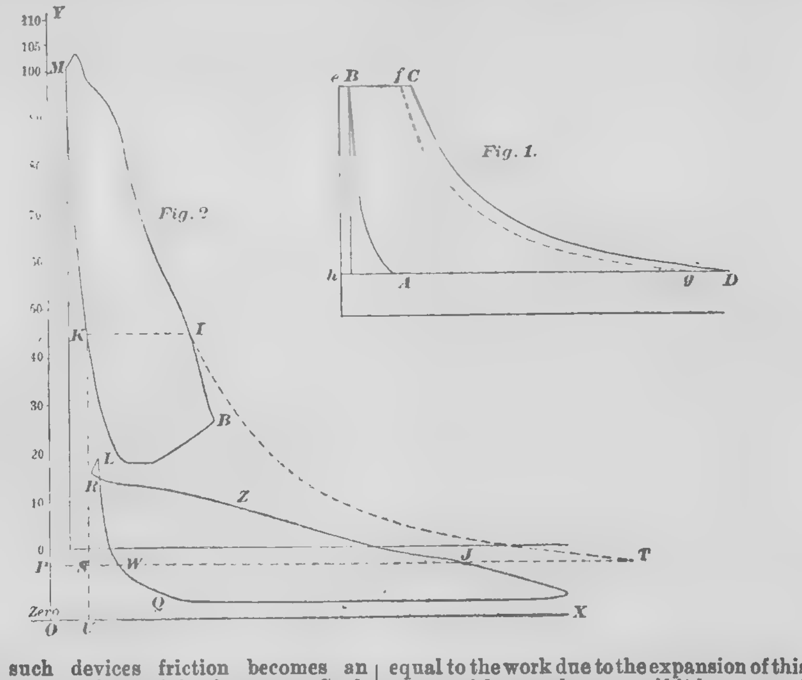
Notwithstanding the high authorities for this, it has been recently asserted by a certain modern writer that such is not the case, but, on the contrary, that friction does increase in proportion to the velocity of the moving body, and that friction is not nor ever was the same independent of the velocity.

Now, while we are not disposed to contradict such men as Morin, Rennie, and Nasmyth, yet it is barely possible that certain conditions may arise where such may be slightly the case. But if friction increased in direct proportion to the speed with the same weight or pressure, the friction upon the journals of very rapid-speeded machinery would be so great that not any known metal would withstand the heat generated in consequence. Take the cylinder of an ordinary planing machine and suppose the frictional resistance upon the journals at 100 revolutions per minute to be 25lb., according to the new theory, at 4000 revolutions per minute the frictional resistance would be 4000 × 25 = 100,000lb., and we submit to any practical planing operator whether it would be possible to successfully run a machine against that amount of friction.

Again, if such were the case, that friction increases as the speed with the same pressure upon the brakes of a train of cars, they should be stopped in the same time running 50 miles per hour as they would at 10. The fact is, friction is often confounded with mechanical resistance, and the unit of friction is simply the power required to overcome the adhesion between the bodies when in a state of rest, and all over that arises from inertia, atmospheric resistance and other forces which properly come under the head of mechanical resistance, and not from friction alone, and these forces may be considered in a future article upon that subject.—"Age of Steel."

Loss of Power by Drop of Pressure Between Cylinders in Multiple-cylinder Engines.*

Theorem.—Let the clearance spaces of an engine be filled with steam at admission pressure by cushioning. Then the greatest work to be obtained by expanding any volume of steam admitted up to cut-off is equal to the work due to the expansion of this steam with zero clearance, if it be assumed that the expansion and compression lines follow the same curve of expansion. Thus in Fig. 1 let A B C D be the actual card. B C is the volume admitted each stroke. Lay off $e f$ = B C and draw the expansion line $f g$ by the same law as for B A and C D. Then is $g h e f$ = A B C D.



Application of Theorem to Multiple-cylinder Engines.—Let Fig. 2 be the actual combined cards of a compound engine, L M and Q R being cushion lines compressing to admission pressure. Let I and J be points

* By J. E. Denton, Hoboken, N.J.; read before the American Association for the Advancement of Science.

of release. Draw K I and P J parallel to O X. Since L M is a compression line, K I is the volume sent into the low-cylinder during exhaus of the high cylinder. Draw K U parallel to O Y. Draw the expansion line I T, treating U as the zero of volume, according to any law of expansion common to engines, as say the Marriote, which is the highest line generally produced by practice. Then if there was perfect action, or no loss of pressure between the cylinders, the volume K I, by the above proposition, should produce the work S K I T before exhaust occurs at J. Hence the difference between the area S K I T and the actual area J W R Z + K I B L measures the loss, and the ratio

$$\frac{\text{J W R Z + K I B L}}{\text{S K I T}}$$

may be taken as a measure of the degree of perfect action. If there is a third cylinder the volume J W is treated as is K I above, and so on for any number of cylinders.

If L M or Q R are part cushion and part lead lines, or if there is no cushion at all, the method still applies, but there is a waste chargeable to uneconomical valve setting, which makes the proposition untrue, inasmuch as the volume K I cannot then produce the area S K I T, even if there was no loss of pressure between cylinders due to cylinder condensation.

The Birmingham Association of Mechanical Engineers.

THE ordinary monthly meeting of the above association was held on Saturday, the 5th inst., at the Midland Institute, Birmingham. The chair was taken by Mr. A. Driver, president, who was supported by Mr. J. Floyd, vice-president. There were about 60 members present. After the ordinary business had been transacted, including a grant from the funds of £10 for the benefit of the family of a deceased member, a paper was read on "Steam Engine Indicators" by Mr. Bancroft, which was illustrated by the lantern. The various forms of indicators in use were shown upon the screen and by models, at the conclusion of which a hearty vote of thanks was passed to the lecturer for his interesting paper, which having been duly acknowledged, the proceedings were brought to a close.

Shipbuilding Notes.

On the 5th inst., Messrs. Ropner and Son, Stockton, launched a steel screw steamer of the following dimensions:—Length over all, 333ft.; breadth, 41ft. 6in.; and depth moulded, 24ft. Her triple-expansion engines are by Messrs. Blair and Co. Limited, and are of 1400I.H.P., with two large steel boilers working at 160lb. pressure.

Messrs. Mackie and Thomson, Govan, launched, on the 2nd inst., a screw steamer built to the order of Messrs. Weatherley, Mead and Hussey, London. The vessel is 170ft. in length between perpendiculars, 25ft. 6in. in extreme width, and 12ft. 7in. in depth (moulded). Triple-expansion engines of 600I.H.P. are to be supplied by Messrs. Muir and Houston, Kinning Park.

A successful launch of an iron screw steamer took place on the 3rd inst. at the yard of Messrs. Edwards' Shipbuilding Company Limited, Howdon. Her dimensions are:—Length over all, 233ft.; breadth, 31ft.; depth moulded, 16ft. The engines are being supplied by Messrs. George Clark Limited, Sunderland, and are of the triple-expansion direct-acting type, having cylinders 18½in. by 30in. by 49in., and 33in. stroke, capable of propelling the vessel at a speed of 10½ knots.

On the 5th inst., there was launched from the shipbuilding yard of Messrs. Schlesinger, Davis and Co., a powerful steel screw tug, for the Tyne Steam Shipping Company. Her dimensions are:—Length, 90ft.; breadth, 19ft.; and depth, 10ft. The engines have been constructed by the North-Eastern Marine Engineering Company at their Wallsend works, and are on the surface-condensing compound system, with cylinders 17in. and 32in. diameter, with a stroke of 24in.

The new steam screw petroleum steamer, "Etelka," built at the Walker shipyard of Messrs. Sir W. G. Armstrong, Mitchell and Co., was taken to sea for a trial trip on the 1st inst. The dimensions are:—Length, 300ft.; breadth, 37ft. 6in.; and depth moulded, 27ft. 6in. She is capable of carrying about 3300 tons on a moderate draught of water. The vessel has a complete installation of electric light by Messrs. J. H. Holmes and Co. The machinery is of the triple-expansion type, by the North-Eastern Marine Engineering Company, having cylinders 22in., 36in., and 59in. diameter, by 39in. stroke, steam being supplied from two steel boilers working at a pressure of 160lb. The engines during the trial gave every satisfaction, a mean speed of 10¼ knots being attained.

Comparison of Friction in Cotton-mill Engines and Gearing to the Actual Work Done.

(*Concluded from page* 184.)

BELT-DRIVING ENGINES.

Example 1.—Pair of horizontal compound tandem engines, with high-pressure cylinders 18in. diameter, low-pressure cylinders 36in. diameter, all 5ft. stroke, making 53 revolutions per minute, or a piston speed of 530ft. per minute. Fly-belt pulley 26ft. diameter, 8ft. wide, for three belts 2ft. 6in. wide, giving a belt speed of 4320ft. per minute.

Indication of full load equals 855·95 I.H.P.

Indication of friction with the whole of the gearing and engines at work equals 241·85I.H.P., being 28 2 per cent. of the total load, leaving an actual load of 71·8 per cent. on the engines.

N.B.—There is some rope-driving, gearing supplied by maker of engines.

Example 2.—Inverted vertical three-throw crank triple-expansion engine, with high-pressure cylinder 14in. diameter, intermediate 22½in., low-pressure 36in. diameter, all 3ft. 6in. stroke, making 65½ revolutions per minute, or a piston speed of 458½ft. per minute.

Crank coupled direct to second-motion shaft.

Indications of full load with boiler pressure of 195lb. work out to 388·8I.H.P.

Indications of friction with the whole of the gearing and engine at work equal 94·5 I.H.P. at 68 revolutions per minute, being 28 per cent of total load.

N.B.—Engines are put in for driving a considerably heavier load. The gearing is badly arranged inside the mill. Some of the line shafts are driven by main belts which are very short and have to be very tight. In some cases the belt is mounted upon another to secure sufficient adhesion for driving the load.

SUMMARY.

SPUR GEARING.

Example.	Full Load. I.H.P.	Average Pressure referred to, L.P. Cyl.	Friction Load. I.H.P.	Average Pressure referred to, L.P. Cyl.	Percentage of Friction to Total Load.	Actual Work Done.	Rim Speed. Feet Per Min.	Revs. Engine.	Revs. of Second Motion.	Ratio of Wheel.
1	1309	21·2	385·76	6·2	29·47	70·53	2324	51	112·2	2·2
2	989·54	27·73	217·49	6·02	22	78	—	—	—	—
3	250	24	87·62	4·3	33·2	66·8	—	—	—	—
4	802·6	22·4	285·5	7·9	35 6	64·4	2025	43	119·5	2·78
5	1044·5	26·9	205·95	5·3	19·7	80·3	2356	51	114·7	2·25
6	840·55	30·6	201·45	7·3	24	76·0	2050	50	102	2·04
7	1008	21	263	5·5	26	74	—	—	—	—
8	1150	22·88	209	7·9	18·17	81·83	2590·5	33	135·8	4·117
9	1145·1	33·3	300·27	8·7	26·2	73·8	2218·5	35½	113·2	3·33
10	820·26	20	207·96	5·09	25·3	74·7	—	—	—	—
			Giving an average of		25·961	74·036	—	—	—	—

ROPE DRIVING.

Example.	Full Load. I.H.P.	Average Pressure referred to, L.P. Cyl.	Friction Load. I.H.P.	Average Pressure referred to, L.P. Cyl.	Percentage of Friction to Total Load.	Actual Work Done.	Speed of Ropes in Ft. Per Min.	Diameter of Ropes in in.
1	1272	18·4	296	4·3	23·3	76·7	5543	1¾
2	724·9	23 9	232·1	8·6	32	68	5146	1¼
3	859	23	274·2	7·3	32·8	67·2	4674	1¼
4	1025	22·6	324·93	6 4	31·7	68·3	4810	1¼
5	978·25	21·4	283	6·2	28·9	71·1	5306	1¼
6	992·9	22·9	310·1	7·1	31·2	68·8	5013	1¼
7	393·5	18 5	126·8	5·9	32·3	67·7	—	1¼
8	1579·52	19	389·4	4·7	24·6	75·4	5123	1¼
			Giving an average of		29·6	70·4	—	—

BELT-DRIVING ENGINES.

							Speed of Belts in Ft. Per Min.	
1	855 95	26·1	241·85	7·3	28·2	71·8	4329	—
2	969	20 8	262·3	7·5	27	73	4158	
			Giving an average of		28·6	72·4	—	—

DIRECT-ACTING OR DIRECT-COUPLED ENGINES.

1	503·85	30·7	99·1	7·4	19·67	80·33		
2	388·8	23·1	94·5 at 68 revs.	6·4	28	72	—	—
			Giving an average of.....		23·835	76·165	—	—

Example 2.—Pair of horizontal compound tandem engines, with high-pressure cylinders 26in. diameter, low-pressure cylinders 40in. diameter, all 5ft. stroke, making 47½ revolutions per minute, or a piston speed of 472½ft. per minute.

Fly-belt pulley 28ft. diameter, 7ft. wide, prepared for three belts each 26in. in width, and giving a belt speed of 4158ft. per minute.

Indication of full load with a boiler pressure of 85lb. works out to 969I.H.P.

Indication of friction with the whole of the gearing and engine at work equals 262·3I.H.P., being 27 per cent. of the total load, leaving an actual load of 73 per cent. on the engines.

DIRECT-ACTING ENGINES.

Example 1.—Horizontal single cylinder condensing engine, with cylinder 32in. diameter, stroke 3ft., making 91 revolutions per minute, or a piston speed of 546ft. per minute.

Crankshaft coupled direct to second-motion shaft.

Indication of full load with boiler pressure of 80lb. works out to 503·85I.H.P.

Indication of friction with the whole of the gearing and engine at work equals 99·11I.H.P., being 19 67 per cent. of total load, leaving an actual load of 80·33 per cent. on the engine.

N.B.—The gearing in this case is old.

The conclusions to be drawn from the examples furnished, although not numerous and varied enough to pronounce a definite and accurate opinion upon, point to the fact that the engines would be found to be fairly efficient in themselves, but that the arrangement, construction, and the lubrication of the gearing is the principal defect. Two examples (No. 4 and No. 6) will prove this point. Example No. 6, engines were indicated without the gearing, the percentage of friction to the total load being 6 per cent., giving an efficiency for the engines of 94 per cent. of power to be transmitted through the crankshaft. Example No. 4, engines were indicated without the gearing, the percentage of friction to the total load being 10·3 per cent., giving an efficiency for the engines of 89·7 per cent.

The power in both cases is transmitted first by spur fly driving wheel and pinion, afterwards rope driving is introduced; the friction of the gearing only in example No. 6 being 18 per cent., the friction of the engines and gearing together being 24 per cent. of the total load.

In example No. 4 the friction of the gearing only was 25·3 per cent., the friction of the engines and gearing together being 35·6 per cent. of the total load.

By a reference to the summary it will be seen that the best results will be found in the gearing engine No. 8, but that No. 5 example in the same class, and No. 1 in the direct-acting engines, run it very closely.

The average percentages of the examples given show less actual work than I had expected to find, and I shall be pleased if any of the members will supply me with accurate data or permission to indicate other examples for the purpose of revising this paper and making it more complete.

In conclusion I would say that the lessons to be learnt from carefully studying the examples are briefly as follow:—

That spur-gearing engines give the best result when not complicated with rope driving.

That rope-driving engines show the best results at high rope speeds, and that direct driving from the main drum is very desirable.

That belt-driving engines for developing large powers are only equal to the average rope-driving engine, with fewer advantages in other respects.

That the direct-acting type of engine is likely to be very efficient.

I will just lengthen my remarks, with your kind permission, for the purpose of making more clear by comparison the loss caused by friction even in an economical job.

Take example 9 gearing and example 5 gearing. If the friction on example 9 to its total load were proportionate to example 5 and its total load, the friction on example 9 would be reduced 75I.H.P. Taking this at 1¼lb. of coal per hour, it gives 112½lb. of coal per hour (1cwt.), or 56cwt. per working week such as they have in our mills. For the year it gives us in round numbers 145½ tons, which, taken at 7s. per ton, makes up an annual sum of £50 18s. 6d. —say £50—per annum more than example 5 in friction alone.

My thanks are due to the following firms and gentlemen:—Mr. Goodfellow, Mr. Hodgson (of Scott and Hodgson), Messrs. Pollitt and Wigzell, Mr. Taylor (of Buckley and Taylor), Mr. John Bartlam, and many outside friends.

North-East Coast Institution of Engineers and Shipbuilders.

(*Concluded from page* 185.)

IN conclusion, I cannot close an address such as this without referring at some length to a question of burning interest and really vital importance to us—viz., technical education.

It is a subject the merits of which are daily becoming more apparent. As we advance in the knowledge of the methods of application and utilisation of motive powers, we need in ever-increasing quantity an acquaintanceship with the phenomena of natural philosophy and of the methods by which they have been made serviceable to us.

Such a knowledge can be gained, and can only be gained, by close and unremitting observation and study.

Unfortunately, as many of you will no doubt know, there is a very lamentable and widespread ignorance of its virtues amongst those who should possess, in an eminent degree, all the knowledge which can be furnished to them by technical education.

It may be that such ignorance is wilful and assumed by those whose lack of energy prevents them from making any effort to acquire a scientific knowledge of their surroundings. If it is so, the law of evolution resulting in the survival of the fittest will ultimately, and at no distant date, convince such of their degenerate unfitness.

I will quote you a portion of a letter written to a technical journal, evidently by one such as I have described. He says: "Simple, practical facts are very much disliked by eminent scientific men; if they cannot give their explanations in high mathematics and high algebra they are not happy. In trying to convince the world of the correctness of their reasonings they generally do it in such high language, surrounded by ever so many algebraic formulæ, that to 99 engineers out of 100 it adds more to their further confusion than to their enlightenment on the subject." Of course, such a statement is an utter absurdity, but I read it simply to show that such opinions do exist.

They serve, however, to emphasise to a sufficient extent the general want there is of scientific training. I will quote one other such, and then consign them to the oblivion which they richly deserve: "The whole theory of stream lines," says this writer, "and of much other germane matter relating to the dynamics of naval architecture, which have been invented by

imaginative mathematicians possessing more facility in the construction of absurd equations than knowledge of the requisite experimental facts which alone can serve as a solid basis for mathematical investigation of physical phenomena, are the merest rubbish, representing nothing as it exists in nature."

Professor Weighton has spoken of the art and science of engineering, and in the absence of a more apt phrase I venture to make use of his words. Perhaps some of you may be amused by the idea of engineering being called an art, as opposed to terming it a science. I would not imply that it is an art as the term is generally used. It is not a fine art. But you will admit there is such a thing as the art and practice of engineering, and the proficient worker in this art is called an artisan.

The artisan is the mechanic. The scientist is the designer and controller of the work the artisan is called upon to execute. And as day by day the development in the design and manifold applications of machine tools increases, so does the need for the skill of the artisan diminish. But contemporaneously with this declining outlet for the handiwork of the mechanic, there is a corresponding and equally increasing requirement for the scientist, or should we say the man who has benefited by the existence of technical education?

At the same time that we are considering the attainment of scientific training we ought not to neglect the study of other subjects—subjects such as would ordinarily come under the heading of general, or probably classical education. We must not forget the sentiment expressed so appropriately in the motto on the escutcheon of the Durham College of Science: "Mens agitat molem"—literally, "Mind overcomes matter."

There are not wanting numerous analogies in the animal kingdom which we might make use of to show that if an individual devotes himself exclusively to one occupation or study, he becomes incapable, by the mere excess of his zeal, of forming an impartial and unbiassed judgment on any matter connected with it, and it is only by simultaneously acquiring a knowledge of other subjects that he can keep up a perfectly independent and healthy mental activity; and by so doing in the individual maintain at its highest in the multitude the level of intellectual and moral individuality, by which means only have we in the past attained to the position which we now hold in the world of commerce, science, and culture, and by which we can only hope in the future to reach the highest ideal of life as a people.

Having now shown, as I hope, that we must not be led away altogether from all other kinds of learning by the cry for technical education, I shall pass from generalisation to the more common-place details of the actual education of an engineering student. Before stating my views on the subject, I should like to say that I do so with all deference to any opinion which any of you may have formed on this matter. I simply tell you the result of observations which are the outcome of my own experience; as you are aware, it is not a very long one, and therefore liable to have some of its deductions amended by further consideration, such as time alone can furnish.

Let us assume that an individual has a natural liking for mechanics, and that before he has left school at the age of 15 he has some slight knowledge of the details of a steam engine—such as being able to distinguish the engine from the boiler or the cylinders from the rods. (I regret to say, incredible as it may seem, that such a knowledge is not possessed by many aspirants to engineering fame and fortune at the age of 15.)

Putting such on one side, I think that the student should attend some institution devoted to scientific (not necessarily technical) education, for a period of not less than two years. The Durham College of Science provides a course such as I suggest. At the end of that time—at the age of 17—the student should enter as an apprentice in some engineering works.

Whatever department of the works it may be in which his lot is cast, he should take a deep interest in and observe as closely as possible work that is carried on in other portions of the works; he may even be fortunate enough to have an opportunity of working in all departments of the mechanical portion of the business. If he does do, his power of observation will be stimulated, and the value of knowledge he derives as the result of his observations will be indefinitely accentuated by the scientific training which he already possesses. If he remains in the works for, say, three years, and then is promoted to the drawing office, he may be fairly said to have started on his career as a scientific engineer. And without break or further academical instruction, except what he may derive from the utilisation of his spare time, there is no reason why he should not attain to satisfactory proficiency or even eminence as an engineer.

If, on the other hand (as is suggested), he should, on leaving school, proceed at once to the workshop, unless he is of very phenomenal constitution, his time for a year or two will be in a great measure wasted—always bearing in mind that he is intended to be a scientist and not merely an artisan. If, now, at the end of a year or two he proceeds to the drawing office for a similar period, he will, at its conclusion, be fit and ready to attend an institution for technical education.

Now herein lies the fatal objection to this method of procedure. At the conclusion of his college course I am afraid he would find very great difficulty in obtaining a situation on the staff of any works at a fairly remunerative salary. You may say that the question of salary should not enter into our consideration, but I think that in nine cases out of ten the salary must necessarily be a question of vital importance.

In leaving this subject may I suggest that it would be interesting to hear the opinions of some of our shipbuilding graduates on the circumstances surrounding their own position with regard to scientific training.

At the beginning of this address I gave you a short history of our life up to the present moment. I now wish you to revert back to yourselves, to review our present, and to take heed for the future. We have now commenced what gives every promise of being an extremely successful year; we are beginning to make a name for ourselves, and we receive consideration as a concrete body. It is a fundamental property of matter that it is indestructible—we cannot diminish in size and importance—we may stand still; but, gentlemen, we must not stand still, and with hearty co-operation between committee and members we shall not.

May I ask that everyone of you will make every personal effort that lies in his power to increase the membership roll, and not only to do that, but to come yourselves and induce others to come with you to our meetings. Well-attended meetings are as the bread of life to us; poorly-attended meetings threaten the destruction of that life and we languish. You will notice I do not ask you to take part in our discussions, because—it is almost a case of the spider and the fly—I am firmly convinced that if you only come you will be impelled by the interesting character of the discussions to take part in them.

As I have made mention before of the difficulty we have had to face in the fact of most of our members being strangers to each other, I may say that in order to overcome such difficulty to some extent, we propose holding a dinner in connection with this section at about the beginning of December, in which undertaking we hope for your hearty co-operation and support.

Finally, gentlemen, may I suggest one or two subjects on which papers would be interesting. We have had a regrettable lack of shipbuilding papers, and it would be of advantage to have one on some such subject as "The Relative Merits of Iron and Steel Ships," say.

I am led to suggest this by two remarks which were made by Mr. Boyd and Mr. Thompson, our first and last presidents respectively, in their inaugural addresses.

Mr. Boyd says, in 1884:—"There is no reasonable room for doubt that we are in a transition stage as regards the material used in the construction of our steamers, and that year by year an increasingly large number will be built of steel."

Mr. Thompson said on Monday last:—"The difference to-day between an ordinary cargo boat built of iron and one of steel is 7 per cent. in favour of the latter, instead of 20 per cent. as at its first introduction, and every month they more nearly approach each other."

Papers on "Docking" or "Launching" would be of interest; and performances of ships on a voyage at sea as to trim, stability, speed, effect of trim on speed, etc., etc.

In engineering subjects offers of papers are not wanting. I would suggest that in view of the fact that the draught of a ship, as a general rule, does not increase proportionally with the increase of linear dimensions in passing from small to large ships, the consideration of the fitting of twin screws in place of a single screw—which is admittedly too small for high speeds—would be a question worthy of investigation or discussion, considered from a shipbuilder's, an engineer's, and also, if possible, from a shipowner's point of view.

A paper also on the relative merits of different types of marine boilers would be most instructive, and meet a long-felt want.

I need not say that I hope this short list that I have given will not deter anyone from writing a paper on any subject not contained in it on which he may have had a desire to do so. I simply suggest them as subjects which give every indication of coming prominently into notice in the near future; therefore, the more we can learn of them, the more fit we shall be to face any emergency involving their consideration which may arise.

Bismuth.

THE metal bismuth was first accurately described by Pott in 1739; for although it had been obtained before that time, it was confounded with antimony and zinc, which it resembles to some extent. The origin of the word "bismuth" is not known, though several highly-improbable origins have been suggested. For example, miners often call it "wismuth," and Mathesius suggests that this word comes from "wisse" or "wiese," meaning a meadow; because, he says, in the mines it is often found covered with incrustations of various colours, resembling a meadow covered with brilliant flowers.

Bismuth occurs in nature in the metallic form, and several ores of it are also found from which the metal may easily be obtained by roasting and smelting. The principal supply comes from Saxony, though it is also found in Austria, Norway, Cornwall, Spain, California, New South Wales, and parts of South America. The total consumption of the metal ranges between twenty-five and fifty tons a year, and the demand for it is so variable that the price has ranged all the way from 2s. to 20s. a pound.

Bismuth is of a peculiar light-reddish colour, highly crystalline, and so brittle that it can readily be pulverised. It melts at 510° F., and boils at about 2300° F. Its specific gravity is 9·823 at 54°F., and 10·055 just above the melting point. Its specific heat is about 0 0301 at ordinary temperatures, and 0 0363 just above its melting point. Its coefficient of expansion is about 0·000736 per degree F. Its conductivity for heat is only about $\frac{1}{12}$ that of silver, and its electrical resistance at 32° is 1·153 times that of mercury at the same temperature. It is readily recognised by the spectroscope, for it has a large number of characteristic lines in its spectrum. Its chemical symbol is Bi, and its atomic weight is 207·523 (Clarke), or, in round numbers, 208. Its tensile strength is 6400lb. per square inch. It has been believed that the specific gravity of bismuth is *diminished* by great pressure, but Spring has shown that this is not the fact. He subjected a sample whose specific gravity was 9·804 to a pressure of 20,000 atmospheres, and found that the specific gravity rose to 9·856. A second compression increased it still further, to 9·863. Bismuth expands in cooling, and Tribe has shown that this expansion does not take place until after solidification. Bismuth is the most diamagnetic element known, a sphere of it being repelled by a magnet; and on account of its marked thermo-electric properties it is much used in laboratories in the construction of delicate thermo-piles.

In the arts bismuth is used chiefly in the preparation of alloys. By adding a small amount of it to lead that metal may be hardened and toughened. An alloy consisting of three parts of lead and two of bismuth has ten times the hardness and twenty times the tenacity of lead. The alloys of bismuth with both tin and lead are extremely fusible, and take fine impressions of casts and moulds. An alloy of one part bismuth, two parts tin, and one part lead is used by pewter workers as a soft solder, and by soap-makers for moulds. An alloy of five parts bismuth, two parts tin, and three parts lead melts at 199° F., and is somewhat used for stereotyping, and for metallic writing pencils.

Catalogues, Price Lists, Etc.

Engineers, Tool Makers, Metal Merchants and others are invited to forward Catalogues, Pamphlets, Circulars, Price Lists, etc., for notice in this column.

WE have received from Mr. G. PHILLIPS, Weights and Measures Office, Oakham, a copy of his "Preparatory Course for Board of Trade Examination of Weights and Measures Inspectors." Mr. Phillips, who is the certified inspector and adjuster for the county of Rutland, has contrived to condense a deal of information in a small compass, and candidates for these inspectorships cannot have a better preparatory course of instruction than that here given.

MESSRS. B. AND S. MASSEY, Openshaw, Manchester, have favoured us with a copy of their illustrated catalogue of patent steam hammers, steam forging presses, power presses, power hammers, steam stamps, forging machines, etc. The catalogue is very complete in every respect, and contains quite a number of illustrations of the forging appliances with the manufacture of which Messrs. Massey have long been identified.

MR. A. G. THORNTON, 109, Deansgate, has just issued a new edition of his very complete catalogue of drawing and surveying instruments, photo. material, etc. Several new specialities have been included in this list, which has been rearranged, the greater part rewritten, and all prices revised.

Trade Notes.

Messrs. Siemens and Halske have secured the contract for an electric tramway between Carlsbad and Giesshübel.

Tenders are invited for 2000 tons of cast iron pipes for the Glasgow Corporation Water Commissioners.

Messrs. William Hamilton and Co., Port-Glasgow, have contracted to build a screw steamer for the African passenger service.

Messrs. Jas. Menzies and Co., of Glasgow, have secured an order for 10,000 iron locomotive boiler tubes for an Italian railway company.

Messrs. William Simons and Co., of Renfrew, have received an order to construct a dredging vessel for special service at Portsmouth Harbour.

Messrs. J. Shewell and Co., of Darlington, are supplying the girders required for the high-level apparatus at the Hudson Dock North, Sunderland.

Messrs. Crompton and Co., electrical engineers, are putting down a new plant, in order to execute their greatly increased business at their Chelmsford works.

Messrs. Hannah, Donald and Wilson, Paisley, engineers, have secured the contract for the wrought-iron washer plates for the cylinders to be sunk in the Cessnock Dock at, Glasgow.

Messrs. Entwisle and Gass Limited, Atlas Foundry, Bolton, have just booked a large order for plate-glass grinding machines, for one of the large English plate-glass manufacturing companies.

Messrs. Shand, Mason and Co., London, have received an order from the London County Council for a new double-cylinder steam fire engine, having a capacity of 450 gallons per minute, and to throw a 1¼in. jet 170ft. high.

The directors of Robert Boyle and Son Limited, ventilating engineers, Glasgow and London, have resolved to recommend a dividend of 12½ per cent., free of income-tax, for the year ending September last.

Messrs. J. and R. Houston, Cartsburn Engineering Works, Greenock, have contracted to construct the entire machinery, plant, etc., for a large sugar refinery in the East, capable of turning out over 3000 tons of sugar per month.

Messrs. Peter Barclay and Co., of Boston, U.S.A., have received an order from the Fairfield Shipbuilding and Engineering Co., Glasgow, for eight sight-feed cylinder lubricators for the triple-expansion engines of the new Cunarders.

Messrs. Richmond and Chandler, of Manchester, are supplying a number of machines to West African rubber manufacturers, for use in cutting up rubber into shreds. This enables them to pack it more conveniently for shipment.

Messrs. Jenks and Co., of the Beaver Ironworks, Wolverhampton, have restarted two sheet mills and several puddling furnaces, which will find employment for between 70 and 80 men. The mills and furnaces have been idle about six months.

Messrs. Bolckow, Vaughan and Co., have taken on lease the Lackenby Ironworks, near Middlesbrough. The works were offered for sale a short time ago as a going concern, but failed to meet with a purchaser. The three furnaces now in blast will be kept in full operation. Messrs. Bolckow, Vaughan and Co. will then have 25 blast furnaces, of which 19 will be working.

Readers of "The Mechanical World" are invited to send to the publisher of "Good Health," the new weekly paper devoted to food, drink, medicine, and sanitation, for a parcel of specimen copies, which will be sent gratis and post free, for distribution among their friends at home and abroad. Address, 391, Strand, London, or New Bridge-street, Manchester.

Wheel cutter in metal only. Every description of gearing. R. CHADLAW, 43, City road, Manchester.

Having regard to the enormous circulation of THE MECHANICAL WORLD, the Editor suggests that it is by far the best medium for the insertion of every kind of "Wanted" advertisement, and the price is only one halfpenny per word. The Editor will be glad if MECHANICAL WORLD readers will kindly bear this in mind as occasion arises.

Parsons' Condensing Steam Turbine.

We have pleasure in directing attention to the following report by Professor Ewing, F.R.S., on a series of trials of Parsons' condensing steam turbine. As will be seen, the results obtained are in every way remarkably good, and in point of steam consumption the steam turbine is found to be slightly superior to the average ordinary type of engine as employed for central-station work :—

Report on Trials of Parsons' Condensing Steam Turbine, using Superheated Steam.

By Professor Ewing, F.R.S.

In December last I carried out a series of trials of Mr. C. A. Parsons' new condensing steam turbine, to determine the consumption of steam under various grades of output. The machine tested was a steam turbine combined with an alternate-current dynamo, capable of an output at the rate of 100 kilowatts, or 100 Board of Trade units of electrical energy per hour. It was then found that the consumption of steam was 37lb. per electrical unit when the machine was running under its full load of 100 units per hour, 39lb. per unit when the load was 50 units per hour, or one-half of the full value, and 43lb. per unit when the load was reduced to a third its full value.

I have now to report the results of a further series of trials, made during the month of August, with the object of testing how far the efficiency has been improved by certain recent changes, and by the use of superheated steam. The same turbine was used in these as in the former trials; but some additional rings of turbine blades were inserted at the high-pressure end to enable it to deal more effectively with pressures up to 115lb. per square inch (absolute), the vacuum was improved by the use of a larger air pump, and by admitting the injection water at a point of the exhaust pipe closer to the turbine, and there was a new governor. The chief factor in the improvement which has now been brought about is, however, the use of moderately superheated steam. The improvement demonstrated by these new trials is very marked. Thus, in the present turbine, with steam superheated 60° F. above the temperature of saturation, the gross amount of feed water is 28·4lb. per electrical unit generated when the machine is working at full load, and 32lb. per unit at half load. By carrying the superheating further (to 125° F. above saturation) the consumption at full load is reduced to 27lb. per electrical unit. Comparing these figures with those of the former trial, it will be seen that the consumption of steam has been reduced by about 27 per cent. What makes these results specially important is the consideration that there is nothing in the construction or working of the turbine to make it likely that the use of superheated steam will be attended by any drawbacks such as have been experienced in engines of the ordinary type. The steam works without lubrication, it comes into contact with no rubbing surfaces, and there is no packing to be injured.

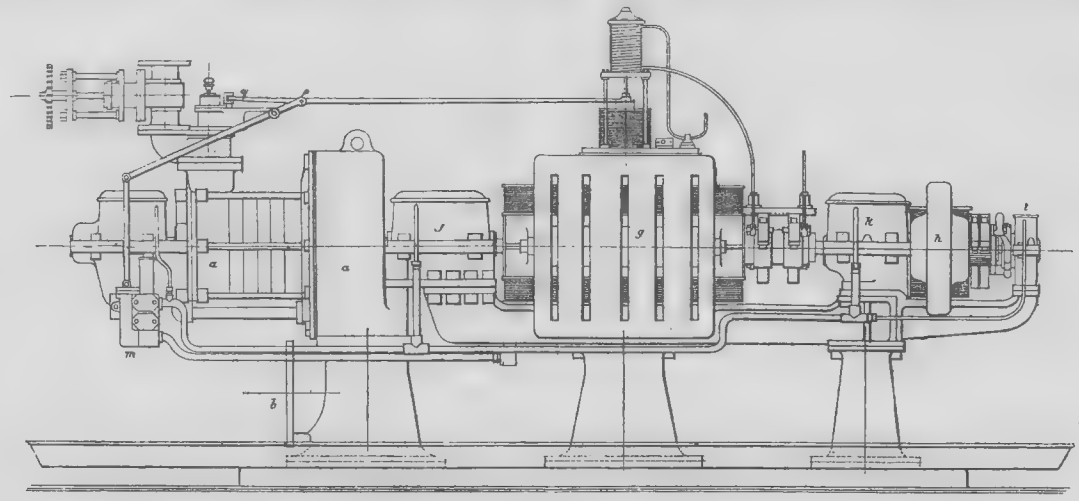


Fig. 1.

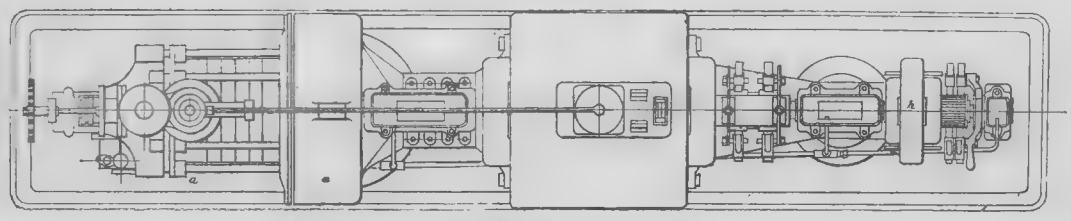


Fig. 2.

A general view of the plant tested is given in elevation in Fig. 1, and in plan in Fig. 2. The turbine case (*a a*) contains a series of seven revolving discs, from the surface of which the turbine blades project. They are arranged, on each disc, in a series of concentric rings. The fixed guide blades stand in spaces between these rings, being carried by annular discs, which are fixed to the case. Thus each revolving disc, with its neighbouring fixed disc, forms a series of outward-flow turbines, the steam entering the series inside the smallest ring of blades and escaping at the circumference into a channel, which conducts it between the back of the revolving disc and of the next fixed disc to the inside of the next series of rings. The arrangement will be understood by reference to Fig. 3, which is a section showing the first three turbine discs. The heights and apertures of the turbine blades on each disc are adapted to the increasing volume of the steam as it expands from an absolute pressure of 115lb. per square inch to an absolute pressure of 1lb. per square inch. The first six discs, which are each 15in. in diameter, are designed to expand the steam to about atmospheric pressure, the remainder of the expansion being performed in passing the seventh disc, which is 26¾in. in diameter, and has (unlike the other six) a double series of rings of blades, one series on each side, through which the steam flows "in parallel." The height to which the turbine blades project above the discs in which they are secured varies from ⅛in. to 1in. The whole number of rings of moving blades in the machine tested was 35. The blades are made of strong sheet brass, and show no sign of wear after continued use. Steam enters the turbine case at one end, through a double-beat valve shown in Fig. 3, and after passing the successive turbine discs is discharged at *b* (Fig. 1) to a condenser. The longitudinal pressure on the turbine shaft, due to the one-sided character of the six smaller turbine discs, is balanced at the high-pressure end by a revolving baffle piston (Fig. 3), with a number of deep grooves on its circumference, which are entered by corresponding projections on a fixed bush resembling a thrust block. Any small amount of longitudinal thrust which may remain unbalanced is received by an adjustable grooved thrust bearing at the end of the spindle, beyond the main bearing. This, which is contained in the oil box *c* (Fig. 3), is shown to a larger scale in section in Fig. 4. The thrust bearing (*d*, Fig. 4) consists of seven collars on the spindle revolving in a grooved bush, which is split longitudinally into halves with separate longitudinal adjustment to allow any wear to be taken up, so that end-shake is prevented, and the endwise position of the shaft is maintained with great precision. This device also gives a means of regulating the amount of clearance over the tips of the turbine blades. The thrust bearing, like the main bearing, runs in a bath of oil.

The main bearings are of a special construction, which is admirably adapted to ensure easy running at a high speed, and to damp out vibration. The shaft (*e*, Fig. 4) rotates in a phosphor-bronze sleeve, outside of which are slipped three concentric steel tubes fitting loosely over one another. The outermost tube (*f*, Fig. 4) is a loose fit in the casting which forms the seat of the bearing. Oil is continuously and freely fed to the bearing from a cistern above, under a head of some 6in., and drains into a chamber below, from which it is automatically pumped back to the cistern. The oil is used over and over again. In this way the small clearance between each tube or sleeve and the one outside of it is kept charged with a film of oil, with the effect that while the shaft retains a necessary small amount of freedom to adjust itself by lateral displacement, the viscosity of the films acts as a powerful damper to prevent oscillation from being set up. The working of the bearing is perfectly satisfactory, and the damping action is so great that the shaft may even be put considerably out of balance without causing the vibration to become excessive, or making the bearings run hot. In the ordinary conditions of balance the shaft carrying the turbines, the main armature, and the exciter armature, runs at 80 revolutions per second, with a steadiness and quietness which are most remarkable.

The shaft passes out of the turbine case at each end through a lantern brass or steam gland. The whole shaft is in three lengths; the first part carries the turbines, the second carries the armature of the main dynamo *g* (Fig. 1), and the third part that of the exciter dynamo *h*. The parts are coupled by means of a square-bored sleeve slipped over squared ends. The couplings are placed in the middle of long double bearings at *j* and *k*. These, as well as the end bearing at *l*, are all formed by concentric tubes, and work drowned in a sea of oil, as already described for the other end bearing. The oil chambers are connected by pipes, so that a single oil-pump maintains the circulation in all. The pump, which is shown at *m* in Fig. 1, is driven by an eccentric which receives its motion from a worm *n* on the main shaft, working in oil, between the main bearing and thrust bearing of Fig. 4.

The governing of the machine tested was accomplished by a novel and extremely effective appliance. Steam was admitted to the turbine in a series of gusts by the periodic opening and closing of the double-beat lift valve shown in Fig. 3. This valve was operated by means of a steam relay in mechanical connection with the turbine shaft, so that the valve was opened regularly once in every 28 revolutions of the shaft. The duration of each gust was controlled by an electric solenoid, which was connected as a shunt to the field magnets, but was compounded so as to keep the volts constant. The core of the solenoid was hung from the end of a long lever *o* (Fig. 1). The fulcrum *p* of this lever was periodically moved up and down by means of a link connecting it with the eccentric, which also served to drive the oil pump. The short end of the lever (*q*) controlled the valve of the steam relay. Each periodic movement caused a gust of steam to be admitted to the turbine, the duration of the gust depending on the height of the distant end of the lever. The effect was, that at full load the gusts became blended into an almost continuous blast, the lift valve closing only momentarily, or not at all, in each of the periodic movements; under any lighter load each interval of admission alternated with an interval during which the steam was completely shut off. The action of the governor was most satisfactory. The periods of admission were so frequent that they caused no material throbbing of speed nor any variation of volts sensible on a voltmeter. There was no hunting, and the freedom from friction was greater than I have seen in any governor. I repeatedly threw the whole load, amounting to over 130 electrical horse-power, on and off suddenly, without causing more than a momentary variation in the volts. The governor was sensitive, quick, and certain in its action to quite an exceptional degree.

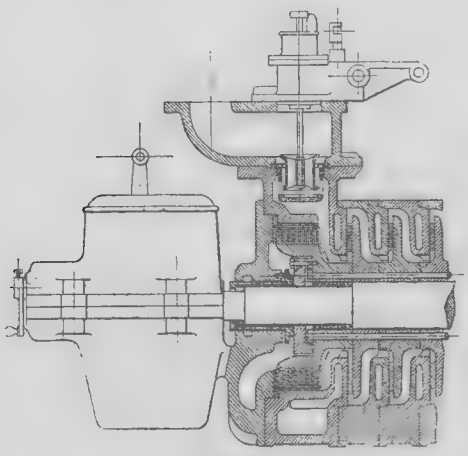


Fig. 3.

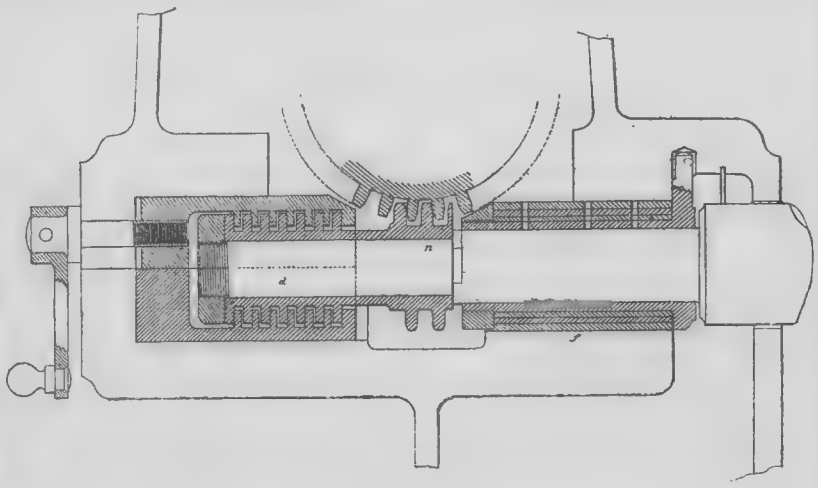


Fig. 4.

By applying an indicator at the admission end of the turbine chamber, below the double-beat valve, observation was made of the pressure during the periodic admission of steam; this was done by pulling the paper drum of the indicator as steadily round as possible by hand while the pencil rose and fell. Figs. 5 and 6 are examples of diagrams obtained in this way. In Fig. 5 the load was about one-half the maximum; in Fig. 6 it was about three-quarters. The pressure which these diagrams show during admission is about 4lb. less than that shown at the same time by a pressure gauge on the steam pipe above the governor valve.

The machine tested was primarily constructed to generate alternate currents up to 50 ampères, with a potential of 2000 volts, and in some of the trials the original alternate-current armature was used. But thinking it desirable to make the tests of efficiency depend on measurements of continuous rather than of alternating currents, in order to avoid any uncertainty which may be held to attach to estimates of the work spent in an alternate-current circuit, I suggested to Mr. Parsons the

desirability of winding a continuous-current armature specially for these trials. He adopted the suggestion, and most of the trials have accordingly been made with a continuous-current armature, wound to give 400 ampères at 250 volts. The original exciter was still used to supply current to the field magnets.

It may be said at once that the results of the continuous-current trials, where the electrical measurement of the work done is of a perfectly simple and straightforward character, are in close agreement with those of the alternate-current trials.

The main armature was about 2ft. 6in. long over the body by 9in. in diameter. The weight of copper on it was only 33lb., or ¼lb. per kilowatt of output.

400° F., which, as the boiler pressure was 100lb. per square inch above the atmosphere, corresponds to about 60° of superheating. In this set of trials the continuous-current armature was used, and the amount of feed water was determined for six different grades of output, from no electrical load up to a load in which the output was at the uniform rate of 102 Board of Trade electrical units per hour, the current being spent on a bank of coils. The results of this set of trials are set forth in Table I. below. The output stated is the amount of electrical work done upon the external circuit, and does not include the output of the exciter. The volts were measured by three Cardew voltmeters, which were tested against each other, and one of them against

current armature was used, giving 2000 volts at a speed of 4800 revolutions per minute, which made the frequency of alternations 80 periods per second. Here the current was directly measured by the Evershed and Siemens instruments, and the volts were determined by (1) a Cardew voltmeter furnished with a resistance specially wound to enable it to read 2000 volts, and independently (2) by another Cardew voltmeter with a step-down transformer having a ratio of 1 to 20. The output was taken to be the product of the effective volts and the effective ampères. In these alternate-current trials the electrical energy was absorbed by a water resistance formed by sticking two rods, to serve as terminals, some 10 yards apart in a

The amount of superheating in the trials of Table I. was comparatively small under light loads, because the boiler fire was not then being forced; from half-load to full load it was nearly uniform.

The results are also exhibited in the curves (Figs. 7 and 8). The rate of electrical output is shown in relation to the whole consumption of feed water per hour in Fig. 7, and in relation to the consumption of feed water per electrical unit in Fig. 8. The line A A in each diagram refers to the first set of the present trials—those of Table I.,—which were made with continuous currents and moderate superheating. The points of observation are marked thus ⊙. The points marked ⊖, which lie very close to this curve and a trifle below it, are for

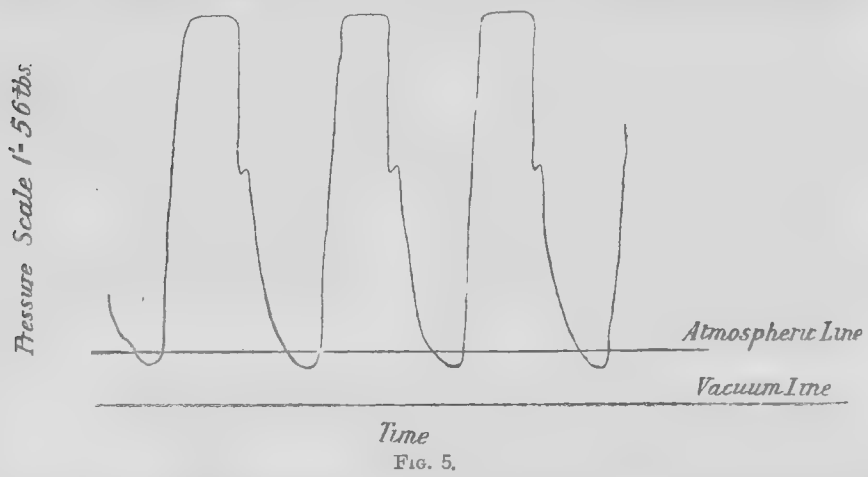


FIG. 5.

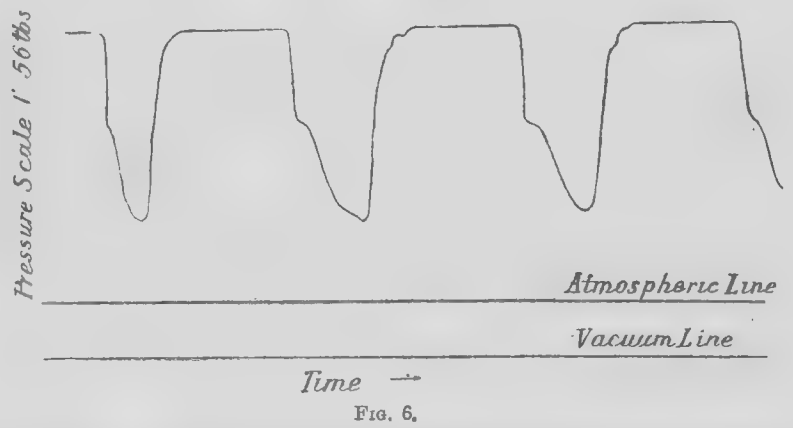


FIG. 6.

Steam for the turbine was supplied, at a pressure of 100lb. per sq. in. by gauge, from a locomotive boiler which was capable of giving enough for the full load of 100 units per hour. The feed water was measured by putting it through a tank, the graduations and total capacity of which I checked by weighing water into it. The contents of this tank were delivered into a second tank, from which the feed pump drew its supply, and in which the level of the water was adjusted to have the same value at the beginning and end of each period of observation. The level of water in the boiler was kept as nearly as possible constant throughout.

In all the statements which follow of the results of these trials the quantity of feed-water named is the gross quantity supplied to the boiler, no deduction having been made for leakage, blow-off at the safety valve, or other loss.

On its way to the turbine the steam passed through an improvised superheater, consisting of eight 9ft. lengths of cast-iron pipe, 8in. in internal diameter. This superheater was placed in the main boiler flue, and, except in a special series of trials noted below, was heated merely by the hot gases from the boiler tubes. The draught was forced by a steam jet from an

a Thomson balance. The ampères were measured in the following way:—A low-resistance frame consisting of many bare thick wires of platinoid, grouped in parallel, was arranged as a shunt to a mirror galvanometer, which was provided with a strong controlling magnet, so that the whole current of about 400 ampères could pass without causing an inconveniently great deflection, and without heating the wires of the shunt materially. In series with this was placed (1) an Evershed ampèremeter which had been carefully calibrated by reference to a Thomson balance, and (2) two Siemens electro-dynamometers, one of which could take the strongest current, while the other was suitable for comparatively weak currents only. The constant of the shunted mirror galvanometer was determined in the low-power trials by comparing its deflection with the readings of the Evershed and of the more sensitive of the two Siemens instruments. These were then cut out to allow stronger currents to pass, and in the trials under heavy load a further check on the constant of the mirror galvanometer was furnished by the readings of the larger electro-dynamometer. The mirror galvanometer, the constant of which remained unaltered throughout, served to connect

pond, the amount of resistance between them being adjusted by pulling the rods out or in to expose more or less of their surface to contact with the water. In this third set of trials the steam was moderately superheated, as in the first set, by the hot gases of the boiler flue only—its temperature again approaching 400° F. The results are given in Table III. The close agreement of them with the corresponding continuous-current trials (Table I.) is important, as supplying evidence that in alternate-current trials conducted in this manner the effects of lag in the external circuit are immaterial; in other words, that the electrical work is properly measured by multiplying the effective volts by the effective ampères. The difference between the alternating and continuous-current measurements is less than 1 per cent. of the output at full load.

In each of the trials the turbine was kept running for a sufficient time beforehand to establish a nearly uniform *régime*, and the trial was kept up long enough to prevent any material error from coming in through inexact readings of the water level in the boiler gauge glasses. In each trial the amount of the feed water was determined during two successive equal periods of time, to test the agreement of these with

the tests made with alternating currents (Table III.).

TABLE I.—TRIALS WITH CONTINUOUS CURRENT ARMATURE, WITH STEAM SUPERHEATED BY THE GASES FROM THE BOILER FIRE ONLY.

Press. by Gauge on Boiler, lb. per sq. in.	Temp. of Steam, ° F.	Load in Elect. Units per Hour.	Feed Water per Hour in lb.	
			Total.	Per Unit.
96	335	0·1	480	—
102	365	10·2	760	74·5
100	356	27·0	1110	41·1
102	400	49·2	1590	32·3
100	390	74·5	2170	29·1
103	398	102·0	2900	28·4

Vacuum in full-power trial:—By mercury column at exhaust, 27½in.; by gauge on condenser, 28½in. Barometer, 29·9in. Temperature of injection water, 73° F. Speed, 4500 revolutions per minute.

The line B B in each diagram relates to the trials with extra superheating (Table II.). The points of observation are marked thus ⊙.

To facilitate comparison, the amount of feed water used per electrical unit at

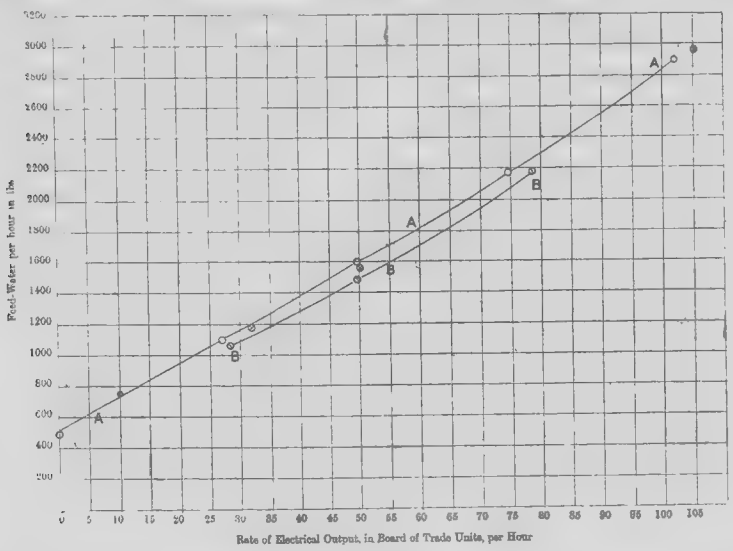


FIG. 7.

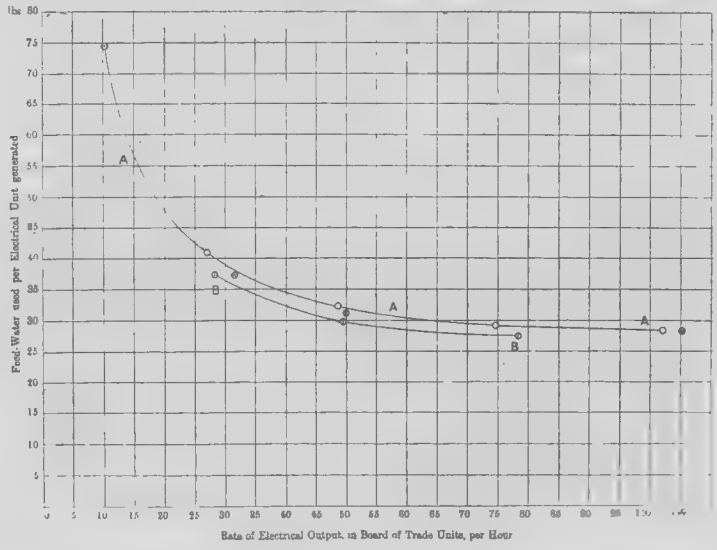


FIG. 8.

auxiliary boiler. Notwithstanding the small size of the improvised superheater, this sufficed to bring the steam from 338° F., the temperature of saturation, to about 400° F. In a special series of trials extra superheating was produced by lighting a furnace built for that purpose in the brick-work enclosing the superheater. With the help of this furnace, the temperature of the steam in these special trials was raised to about 465° F.

Three separate sets of trials were made, August 11 to 15, 1892. In the first set the steam was superheated by means of the hot gases from the boiler furnace only. The temperature approached but did not exceed

the readings of all the currents, from the lightest to the heaviest loads. The agreement between the various measurements was perfectly satisfactory.

In the second set of trials the object was to test the effect of additional superheating. A special furnace, built into the uptake of the boiler flue, was made to give additional heat to the superheater, forcing the temperature of the steam to 465° F. In this set of trials the continuous-current armature was again used, and the measurements were made in the same way as in the first set. Three different grades of output were tested. The results are given in Table II.

In the third set of trials the alternate-

each other. The air pump and feed pump were driven by donkey engines, the steam for which was supplied from a separate boiler, and is not included in the figures given below. What the tables give is the gross amount of feed water actually delivered to the main boiler, from which the whole supply of steam for the turbine was drawn.

The temperature of the steam was read by a thermometer placed in a mercury pocket in the steam pipe, close to the turbine. A pressure gauge placed there showed that the pressure was, at full load, between two and three pounds per square inch less than the pressure at the boiler.

various rates of output, as measured from the curves of Fig. 8, is given numerically in Table IV.

The trials show that a very considerable advantage is realised by moderate superheating. To superheat the steam from, say, 338° F., the temperature of saturation for a boiler pressure of 100lb., to 400° F., requires the addition of barely 30 units of heat, which is less than 3 per cent. of the heat taken up in the boiler. With steam superheated to this extent the consumption of full load is less by one-fourth than the consumption in the old trials. How much of this increase in economy is due to superheating alone cannot well be distinguished

without further trials, as the comparison is complicated by the other improvements referred to at the beginning of this report. It is clear, however, that superheating is responsible for a great part of the difference. Apart from the increased volume of the working substance, the advantage of superheating is to be ascribed in part to the prevention or reduction of the condensation at entry, which would otherwise take place in consequence of the intermittent character of the admission; and in part to its influence in keeping the steam dry during its expansion, and thereby reducing the internal resistances. At full load, when the steam enters in a nearly continuous blast, the latter effect is no doubt the more important.

TABLE II.—TRIALS WITH CONTINUOUS-CURRENT ARMATURE, WITH EXTRA SUPERHEATING.

Press. by Gauge on Boiler, lb. per sq. in.	Temp. of Steam, °F.	Load in Elect. Units per Hour.	Feed-water per Hour in lb.	
			Total.	Per Unit.
102	463	23·3	1080	37·5
102	468	49·5	1480	29·9
101	465	78·4	2170	27·7

Vacuum by gauge on condenser, 28½in. Barometer, 29·5in. Temperature of injection water, 72° F.

TABLE III.—TRIALS WITH ALTERNATE-CURRENT ARMATURE AND WATER RESISTANCE: SUPERHEATING BY THE GASES FROM THE BOILER FIRE ONLY.

Press. by Gauge on Boiler, lb. per sq. in.	Temp. of Steam °F.	Load in Elect. Units per Hour.	Feed Water per Hour in lb.	
			Total.	Per Unit.
99	367	31·6	1180	37·3
97	391	49·9	1550	31·1
103	399	105·2	2970	28·2

Vacuum in full-power trial:—By mercury column at exhaust, 27½in.; by gauge on condenser, 24½in. Barometer, 29·6in. Temperature of injection water, 72° F.

TABLE IV.—CONSUMPTION OF FEED WATER AT VARIOUS RATES OF OUTPUT, WITH SUPERHEATING.

Rate of Output in Elect. Units per Hour.	Feed Water per Elect. Unit.	
	With Superheating to about 440° F.	With Extra Superheating to 465° F.
20	48	—
30	36	36½
40	34½	32
50	32	29½
60	30½	28½
70	29½	28
80	29	27½
90	28½	(27)
100	28½	(27)

The further advantage realised by superheating to 465° F. is comparatively small, especially at high loads. From evidence given by the temperature of the turbine case, it was clear that this amount of superheating not only kept the steam dry throughout its whole course through the turbine, but left it still considerably superheated at the end. The part of the case next the exhaust, which had been quite cool in the trials of Table I., was decidedly hot in those of Table II. This observation agrees with the result of calculation, which shows that an initial temperature of about 443° F. would be high enough to prevent the steam from becoming wet as it expands.* It may be concluded from this consideration, as well as from the results of the trials, that very little increase of efficiency is to be brought about by carrying the superheating further than this. It seems, therefore, undesirable to push the superheating to a higher point than can readily be reached by the use of a superheater in the boiler flue. With a superheater of moderate size, the hot gases of the uptake will furnish as much superheating as need be aimed at, and as much as is sufficient to secure highly economical working.

The general result of the trials is to demonstrate that the condensing steam turbine is an exceptionally economical heat engine. The application to it of moderately superheated steam has put the performance of the turbine on a level with that of the best steam engines of the ordinary type. A consumption of 27 or 28lb. of steam per electrical unit at full load, and 30 or 32lb. at half load, is a result that does not need to have its significance emphasised. The efficiency under comparatively small fractions of the full load is probably greater than in any steam engine, and is a feature of special interest in relation to the use of the turbine in electric lighting from central stations.

The consumption of 28lb. per unit corresponds to 20·9lb. per electrical horse-power per hour. To facilitate comparison with other engine trials, it may be useful to estimate from these results what may, by analogy, be called the "indicated" horse-power of the turbine—that is to say, the mechanical work done by the steam on the turbine blades. The curves of Fig. 7 are nearly straight lines, and by prolonging them backwards to meet the base line produced, it appears that the *idle work*—that is to say, the work done without useful output—was equivalent to 27 kilowatts, or 36H.P. The effective work at full load, the equivalent of 100 electrical units per hour, was 134 electrical horse-power. Hence, if the idle work had the same value at full load as when the machine was running light, the total work done by the steam at full load would be 170H.P., and the effective work (134H.P.) would be 79 per cent. of the total. But the idle work certainly increased when the machine was loaded, and it will be nearer the truth to assume that the effective work was not more than 75 per cent. of the total work. This would make the total work about 179H.P. On this basis, a consumption of steam at the rate of 28lb. per electrical unit is equivalent to 15·7lb. of feed water per "indicated" horse-power-hour, and 27lb. per unit is equivalent to 15·1lb. per "indicated" horse-power-hour. Similarly, the consumption of half load is equivalent to about 17lb. per indicated horse-power-hour.

No allowance, as has been said, was made in these trials for leakage of steam and water from the boiler. It is well known that some leakage occurs under the most favourable conditions, and that if the quantity of steam used were measured after passing through the engine—as is often done in tests where a surface condenser is used,—the results would be more favourable than those obtained by direct measurement of the feed. In the present instance it appeared (from separate observations) that the losses by leakage amounted to about 90lb. per hour, or, say, 3 per cent. of the whole consumption in the full-power trials. If this allowance were made, the quantities of steam per horse-power-hour and per unit would be reduced below the values stated above by about 3 per cent. in the full-power trials, and by about 6 per cent. in the half-power trials.

By applying the indicator at various parts of the turbine case, the range through which the pressure varies as each gust of steam passes, and the fall of pressure from one set of turbine-rings to the next throughout the series, may be examined. This was done during the trials, with the result of showing that the apertures of the several turbines were not adjusted in the best possible relation to one another; in particular it was found that the turbine rings on the large disc at the condensing end gave too free a passage, and were doing less than their proper share of work. The readjustment of areas indicated by this test as desirable will no doubt secure even better results.

Apart from the other possible applications of a peculiarly light and efficient high-speed motor, the turbine dynamo in its present state is, in my opinion, eminently well fitted for central-station use, not only on account of its economy of steam under both heavy and light loads, but also on account of its exceptional lightness and compactness, its small first cost, its independence of foundations, its freedom from vibration, its steady governing, its simplicity, the ease with which it is handled, and the moderate outlay which it may be expected to require under the heads of maintenance, oil, and attendance. So far as I have been able to judge, the performance of the machine is as excellent as its details are ingenious.

* Taking the initial pressure as 115lb. per square inch absolute, the temperature of saturation is 338° F. Superheating to 443° F. makes the total energy of each pound of steam at admission 1235 thermal units. Each pound does work equal (at full load) to about 1-28th of an electrical unit: and the thermal equivalent of this is 122 thermal units. Hence, if we neglect the small loss of heat which occurs through radiation and air convection from the turbine case, steam at 100lb. pressure initially superheated to 443° F. will retain at exhaust a total heat of 1113 thermal units. This makes it just saturated, for 1113 thermal units is the total heat of 1lb. of saturated steam at the final pressure of 1lb. per square inch.

It is reported that Messrs. Sharp, Stewart and Co., of the Atlas Locomotive Works, Springburn, Glasgow, have received orders for the construction of 32 locomotives. The orders are from various quarters, there being 8 locomotives from the Cambrian Railway in Wales, and 20 from the Bombay, Baroda, and Central Indian Railways.

Slipping Belts.

There is unquestionably a large amount of loss in power transmission by belting, due in the first place to the use of narrow pulleys and insufficiently wide belting, but also to the want of a little attention in order to keep them in a clean and pliable condition. In many situations, belting rapidly becomes stiff and hard, absorbing a large amount of power by its resistance to bending it passing round the pulleys, as well as by slipping due to the reduced surface contact. In any case, the durability of the belt is impaired, so that to the loss of power which is being continually incurred there is to be added the increased cost of maintenance. We have had recently brought under our notice the "Universal" friction paste for driving belts, manufactured by Messrs. Barratt, Woodson and Co., Sheffield, which appears to be a very satisfactory compound for belts, as it keeps them in a pliable condition, thus increasing their driving power, while at the same time it acts as a preservative of the leather. The makers claim that it contains nothing calculated to injure the belting, no resin, glue, or acids being used in its manufacture. This substance is being largely used, and judging from the number of excellent testimonials which the firm possess, it would seem to fulfil its purpose very satisfactorily.

Metal Trade Memoranda.

A new iron ore field is to be opened out in Hanover Valley, New Mexico.

The export of gold from Cape Colony during the month of October amounted in value to £378,980.

Messrs. Huldschinsky Bros., of Gleiwitz, Germany, are about to erect a new pipe-rolling mill at Schönbrünn.

Palmer's Shipbuilding and Iron Company have blown in another furnace at Jarrow, which had been idle since the Durham strike.

The St. Etienne Steel Works made a net profit during the year ending June 30 of £50,836, as compared with £45,348 in the preceding year.

The first consignment of American pig iron destined for the United Kingdom is now on its way from New York in the White Star liner "Tauric," which sailed on the 2nd inst. with 200 tons of that material.

It is stated that Messrs. Merton, copper merchants, have just acquired the copper works at Swansea which for the past century have been owned by the Grenfells. As was lately announced, the Messrs. Grenfell recently decided to retire from the business of copper smelters and spelter manufacturers, and with this object are now winding up the company which bears their name.

The copper statistics for the month of October show the deliveries to have been 8990 tons, against 8368 tons in September; and the supplies in England and France at 6586 tons, against 7132 tons. Stocks have declined from 58,482 tons in September to 56,278 tons. Imports from North America and Spain and Portugal show a distinct reduction, the latter declining from 1619 tons to only 762 tons.

New Companies.

Amalgamated Society of Engineers' Institute Limited.—This company was registered on the 2nd inst. with a capital of £1200, divided into 1200 shares of £1 each, to establish an institute in Hull to be used for general meetings, social gatherings, concerts, and such other purposes as may be determined. The rules of table A mainly apply. Registered by Messrs. Jordan and Sons, 120, Chancery-lane, W.C.

Glauber-Ferrite Syndicate Limited.—This company was registered on the 1st inst., with a capital of £25,000, divided into 2500 shares of £10 each, to carry on the business of glauber-ferrite manufacturers, and of plant, machinery, and materials therefor, either as principals or agents, and especially in relation to dealing with inventions or letters patent, or rights therein; to carry on the business of civil, mechanical, and electrical engineers, or any other business in connection with any invention or processes in which the company may be interested. The number of directors is not to be less than 3, nor more than 9, exclusive of a managing director; qualification, £500; remuneration, £150 per annum for each director, and £100 per annum extra for the chairman. Registered by Messrs. Baker, Blaker and Hawes, 117, Cannon-street, E.C.

Dominion Electrical Company Limited.—This company was registered on the 29th ult., with a capital of £25,125, divided into 5000 ordinary shares of £5 each and 500 founders' shares of 5s. each, to carry on the business of a telegraph, telephone, and electric light, heat, and power supply company, and in particular to acquire, establish, work, manage, control and regulate works and conveniences for the supply of electric light, heat, and motive power, and to transmit and facilitate the transmission of telephonic and telegraphic communications and messages, and to undertake the lighting of towns, streets, buildings and other places, and the supply of electric and motive power for public and private purposes. Until otherwise determined, the number of directors is not to be less than 5; qualification, 50 ordinary or 10 founders' shares; remuneration, £1000 to be divided. Registered by Mr. F. A. Rehder, 14, Mincing-lane, E.C.

Bristol Metal Company Limited.—This company was registered on the 27th ult., with a capital of £2000, divided into 1500 "A" shares of £1 each and 500 "B" shares of £1 each, to adopt and carry on the businesses of galvanisers, tinners, manufacturers of tin and galvanised iron goods of all kinds, metal and general merchants, smelters, refiners of metals, and metallurgists in all its branches, and any other business of any description which it may be thought for the benefit of the company to engage in. The number of directors is not to be less than 3, nor more than 5; qualification, 10 shares; remuneration not stated. Registered by Waterlow and Sons, Limited, 85, London Wall, E.C.

Anthracite Association for the Promotion of the Use of Anthracite Smokeless Coal Limited.—This company was registered on the 31st ult., with a capital of £10,000, divided into 10,000 shares of £1 each, with power to increase or reduce same, to carry on any class of business, whether manufacturing or otherwise, which may be or seem calculated to promote the use of anthracite coal. The company may from time to time appoint any one or more of their body as managing director or directors, or manager or managers, for all or any of the purposes of the company, and fix the amount of his or their remuneration. The company may also appoint directors in a general meeting. Registered by Messrs. Deacon, Gibson and Medcalf, 4, St. Mary Axe, E.C.

Trade Marks.

The following is the Official List of Applications published from October 26 to November 2, for the Registration of Trade Marks, so far as relates to the Metal Trades.

CLASS 13.

PENGUIN.

167,151. Metal goods not included in other classes, but not including horseshoes or any goods of a like kind. Volkart Brothers, 11, Billiter-square, London; merchants.—16th September, 1892.

CLASS 18.

TITAN

167,016. **Boilers for heating apparatus and** hot water supply. Walter Jones, trading as Jones and Attwood, 4, Enville street, Stourbridge, Worcestershire; engineer and iron-founder.—10th September, 1892.

CLASS 35.

"The essential particular of the Trade Mark is the device, and the applicant disclaims any right to the exclusive use of the added matter."

166,579. Driving belts, consisting principally of hair or wool. Harry Clement Parkes, 1 and 3, Macdonald's Buildings, Blue Boar-court, Manchester, Lancashire; belting manufacturer.—18th August, 1892.

Official Gazette.

Partnerships Dissolved.

D. N. Druce, R. A. Druce, A. C. Miles, O. E. Druce, and C. N. Miles, Upper Thames-street, E.C., West Bromwich, Coneygreaves, near Birmingham, and Long-lane, Bermondsey, iron merchants, so far as regards the said A. C. Miles.

J. Borland, R. Warren, and H. Austin, under the style of the Hope Foundry Company, Upper Thames-street, E.C., ironfounders and merchants.

A. H. Bateman and A. P. Mack, under the style of Arthur H. Bateman, Westcombe-hill Works, East Greenwich, emery-wheel makers and engineers.

D. Barnett and J. A. Cooke, under the firm of Barnett and Cooke, West Bromwich, screw and rivet manufacturers.

THE BANKRUPTCY ACTS, 1883 AND 1890

Adjudication.

A. Abercrombie, trading as Abercrombie and Son, Whitfield-street, Tottenham Court-road, and Balham Park-road, London, brass-founder and finisher.

Receiving Order.

E. Yates, Leeds, mechanical engineer.

The Metal Market.

PRICES CURRENT.

LONDON, Nov. 7.

Copper opened with cash buyers at £45 10s., and initial business was done for three months delivery at £45 18s. 9d. Values steadily improved to £46, and £46 1s. 3d. three months, and cash was placed at £45 10s. to £45 12s. 6d., in sympathy with the upward Tinto movement in Paris; but later in the day, owing to a desire to realise, prices were slightly easier for near deliveries, which sold at £45 11s. 3d., but three months was steady at £46 1s. 3d. Final rates are 2s. 6d. better on the day. Sales, 400 tons

Settlement price, £45 10s. English tough, £49 to £49 5s.; best selected, £50; strong sheets, £58.

TIN was fully 2s. 6d. higher on early sales, £95 5s. being paid for late January, and £94 17s. 6d. for near prompts, the buying being good and offerings light. The market ruled steady, the only change being a disposition on the part of holders to give a longer prompt, three months being generally sold at £95 5s., and one month at £95, the market closing steady at the improvement. Sales, 125 tons. Settlement price, £94 17s. 6d. English ingots, £97 10s. to £98.

PIG IRON has been firm, with an upward tendency, but the only business recorded was for 500 tons for delivery in a few days at 41s. 3½d. The shyness of buyers in the afternoon supplies the reason for the easier close; but the final value of Scotch was quite ½d. better than on Friday. Settlement prices: Scotch, 41s. 3d.; Middlesbrough, 37s. 3d.; hematite, 47s. 3d.

TINPLATES remain steady. I.C. cokes, f.o.b. London, 12s. 9d.; Liverpool, 12s. 3d.; Swansea, 11s. 9d.

LEAD is 2s. 6d. better on an improved demand. Spanish, £10 5s. sellers; English, £10 7s. 6d.

SPELTER closes easier, with November shipment offered at £19, Belgian or American.

ZINC SHEETS. — Silesian dull but steady. Ordinary, £22 2s. 6d. ex ship sellers. Belgian steady. V.M. brands, £22 5s. ex ship, and £22 f.o.b. Antwerp.

OFFICIAL CLOSING QUOTATIONS.

	£	s.	d.	£	s.	d.
COPPER—						
G. M. B.—Cash	45	11	3	45	18	9
„ Three months	46	1	3	46	8	9
English tough	—			—		
Best selected	—			—		
Strong sheets	—			—		
TIN—						
Fine foreign—Cash	94	17	6	95	7	6
„ „ Three months	95	5	0	95	15	0
Australian—Cash	95	7	6	95	17	6

	s.	d.
PIG IRON—		
Scotch warrants—Cash	41	3
„ One month	41	5½
Middlesbrough—Cash	37	3
„ One month	—	
Hematite—Cash	47	3
„ One month	—	

Miscellaneous Items.

A very rich reef has been discovered at Umfuli, Mashonaland, below old workings, from which it is computed that the ancients must have extracted large quantities of gold.

The Taff Vale Railway Company have been experimenting with electric light in their carriages, but not with success. They intend to use Pintsch's oil gas, on the same principle as on the Midland and other railways.

The Astronomical Society have received from the Cape of Good Hope a specimen of celestial photography, in which there can be counted, by the aid of a microscope, 50,000 stars of various magnitude. The plate was exposed three hours, and the apparatus regulated by clockwork.

According to a recent report there were 4272 electric lighting plants throughout Germany, excluding Wurtemberg and Bavaria, at the end of June last. In connection with these, 733,025 incandescent and 39,945 arc lamps were in use. There are also 20 electrolytical plants and 53 electric-power transmission plants in use.

The railway from Huangshihkang, on the Yangtszekiang, to the iron mine at Tiehshan, China, is reported to be finished. The line is about 17 miles long. The iron ore at Tiehshan is so plentiful that it has been found most economical to use it for ballasting the line. It is also said to be remarkably rich, and the deposit to be practically inexhaustible.

Another discovery of gold has been made in Western Australia, within 100 miles of the Southern Cross Mine. One prospector has obtained 554oz. of gold in a few days, including one nugget weighing 21oz. The news of this find has caused a great rush of miners from Southern Cross to the new goldfield.

The largest locomotive in America is said to have just been turned out from the workshops of the Union Pacific Railroad at Omaha, Nebraska. The engine is 15ft. 5in. high from the rails to the top of the chimney. The boiler is 5ft. in diameter and 23ft. 4¾in. long, and contains 252 2in. tubes, each 11ft. 6¾in. long. An average steam pressure of 180lb. will be employed.

Queries.

☞ Readers are invited to avail themselves of this section for practical information on questions relating to Mechanical Engineering and the Scientific Industries.

☞ Queries and Replies should arrive at the Manchester Office not later than by the first post on the Tuesday preceding the date of publication.

CASTINGS.—Can any reader inform me how to secure clean castings which have wrought-iron pieces "cast in."?—L. U.

GEOMETRY.—Will any reader give a rule for the diameter of the largest circle which can be drawn within an isosceles triangle?

CONVERTING GAS ENGINES.—Will any reader kindly inform me how to convert a Crossley's gas engine, 15H.P., slide-valve type, to a tube firing type?—FITTER.

SWEDISH BESSEMER STEEL.—Can any reader inform me how Swedish Bessemer steel is made, and also give highest amount of carbon it contains?—FORGEMAN.

COATING FOR WATER PIPES.—Can any reader tell me how to ascertain whether cast-iron pipes have been properly coated with Dr. Smith's solution?—WATER PIPE.

MOULDING SAND.—Will any reader inform me where the fine moulding sand is obtained which is used for making small malleable-iron castings in Walsall?—IRON FOUNDER.

FLANGING PLATES.—Will any reader kindly let me know which is the best way to flange plates 2ft. 6in. diameter by ⅜in. thick? I must flange them by hand, as we have no flanging machine?—BOILER.

HARDENING AND TEMPERING.—Can any reader inform me how to harden and temper number of straight steel wires 13 gauge and 16in. long? I have tried several ways, but I cannot keep them straight. I may say that I have hardened them in oil, and one at a time.—BLACKSMITH.

LOSSES IN STEEL FURNACES. — Could any reader kindly inform me the average per cent. of actual loss, and the average per cent. of skull, in the charge of a Siemens open-hearth steel furnace working charges of from 30 to 40 tons? And also the percentage of loss in heating slabs and ingots in the Siemens regenerative gas furnace?—J. R. R.

Replies.

☞ Owing to the constant increase in our correspondence, we regret that we have no alternative but to announce that we cannot reply by post to Queries even when stamped envelopes are sent.

☞ Queries and Replies must in all cases be accompanied by the names and addresses of the writers, as no notice will be taken of anonymous communications.

J. C. C.—You have omitted your address.

G. H. K.—We are unable to trace your query.

A. FARADAY.—Upper Brook street, Manchester.

SHEARMAKER.—We have sent you some particulars, which may be of service.

R. A. C.—See article "Engineering Pattern Making," in our issue for Nov. 1, 1890.

G. S. PECK.—See MECHANICAL WORLD, March 24, 1888 (paper read before Inst.C.E.).

ANXIOUS ONE.—(1.) Not to our knowledge. (2.) Yes. (3.) We have heard nothing of it.

VACUUM. — Reynold's "Continuous Railway Brakes," 9s., may be had from our office.

GAS ENGINEER.—Messrs. J. Stott and Co., 174, Fleet-street, London, will supply you with full particulars.

DOUGHTY (Oldham).—It is said that a few clean oyster shells will prevent domestic boilers from rusting; try it.

LOCO.—An intelligible sketch would occupy too much space in the reply column. We will take an early opportunity of illustrating an engine of the type named.

CIRCULAR SAW.—Yes, it is quite practicable, provided you have the necessary pressure of water. Mr. F. Pitman, Aubrey-road, Withington, Manchester, will give you particulars of cost of working.

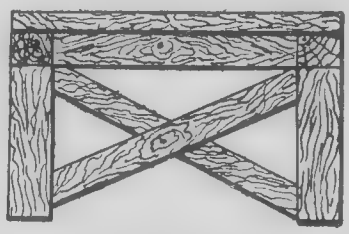
DYNAMO.—You can apply the principle of the friction brake strap, and the horse-power lost in overcoming friction will be

$$\frac{\pi \times 3 \times 100 \times 28}{33{,}000} = 0{\cdot}8 \text{H.P.}$$

BOILERMAKER.—You may take it that the expansion will be 0·000004 of the diameter per degree F. So that if it is 15ft. at 60° F., at 70lb. pressure it will be 15ft. 0·162in. diameter, and 15ft. 0·216in. at 160lb. pressure.

ROTARY (1).—Information about the engines you name may be obtained by consulting the indexes and specifications of patents in the nearest public free library, or the manager of our patents department would be pleased to arrange to make a search for you at a reasonable cost. A pamphlet is being sent to you giving further information. The drawings themselves cannot be patented; the subject they represent can. No model is needed. (2.) About 910ft. per second.

WOOD STAGING.—How are the strains and sizes obtained of the timber platforms as sketched, supposing the framework to be, say, 10ft. square and 8ft. high, supporting a load of 4 tons? Under what conditions does it become necessary to use the diagonals, and



how are the requisite sizes arrived at? What is the best method of connecting? Should the diagonals pass one another, be halved, or one butt against the other?—STAGING.——*A.*—The 10ft. × 10ft. stage would probably have at least four rows of posts and diagonals, or eight posts in all. Over the heads of these should lie stout sleepers, on which will come the joists spanning from post to post. You do not state the nature of the load; but supposing the worst condition of load is with 2 tons in the centre of one joist, or 4 tons evenly distributed over one, then each post must be able to take safely 2 tons, acting as a strut. To do this with a factor of safety of eight it should be 4½in. sq. at least, if of average pine. This can be found by the following formula:—

$$B = \frac{5000}{1 + \left(\frac{L^2}{B^2} \times 0{\cdot}004\right)}$$

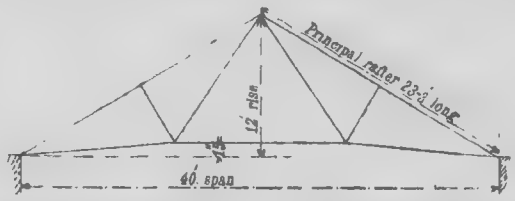
Where B = breaking load in lb. per sq. in. of area of section of strut; L = length of pillar in inches; B = breadth of side of pillar in inches, or diameter of round pillar. Now to calculate the scantlings of the joists, suppose them to be 4in. wide, and use a factor of safety of 6. Then:—

$$(\text{Depth b})^2 = \frac{\text{Lgth. in ft.} \times \text{breaking wght. in lb.}}{\text{Inches of breadth} \times \text{constant}}$$

$$= \frac{10 \times (6 \times 2 \times 2240)}{4 \times 370 \text{ (for fir)}} = 181{\cdot}6$$

∴ Depth of beam = $\sqrt{181{\cdot}6} = 13{\cdot}4$in. The diagonals are necessary in case of any force acting in a horizontal or inclined direction which would tend to overturn the staging. It is scarcely necessary to calculate the scantlings of these unless a definite force of some magnitude is expected whose amount and direction can be estimated. Make them of good stiff sticks, and let one butt against the other, the butts being in alternate directions in the alternate bays. In the whole structure avoid cutting up the pieces by mortising as much as possible, and use cleats, etc., freely.—T. J. B.

ROOF TRUSS.—Required to find the stress on each member of a wrought-iron roof truss, and also the best form of section to be used for each member—*e.g.*, if it was found that the cross sectional area of one of the tie rods was 2in. square, would it be best to use a bar, say, 4in. by ½in., with the deepest part downwards, in preference to a round bar of equal area? Would it form a more rigid and stronger framework built up of flat bars and analogous sections, such as T-angle, channel, etc., instead of bars of a round section? The weight of each truss I have assumed as 950lb. The load due to corrugated iron covering, etc., is 2lb. to the square foot, and to this I have assumed weight of snow to be 5lb. per square foot, allowing for it being 12in. deep, thus making it, say, 7lb. per square foot. I understand how to construct the diagram according to Clerk-Maxwell's method (p. 150, Molesworth's Pocket-book); but my chief difficulty is how to place the loads when knowing the weight of the framing and the load when given in so many lb. per square foot.—C. PERCIVAL.——*A.*—If, as you say, you have mastered the subject of the strains, the first part of your query appears superfluous; but the diagrams I enclose dealing with them in a different manner to Mr. Clerk-Maxwell may make it clearer to you—



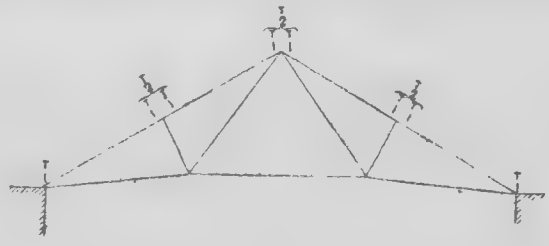


DIAGRAM 1.

treating them by the parallelogram of forces, pure and simple. As to apportioning the loads, this will be in the manner hereinafter mentioned, assuming a distributed load of 8 tons. The common method (Adams') is to "assume that each point of support carries half the load between itself and the next support"; and as this particular truss is divided into four bays, the distribution will be as per diagram 1 and the strains as per diagram 2. The rafters are usually and advisedly made of either angle irons, back to back, or of T-iron; the struts either of angle iron or of two flats, kept apart by ferrules. The tie rods are undoubtedly best of round iron, although the main tie rod is sometimes made of flat iron, in order to save smithing in the lighter and cheaper class of roofs. In the writer's opinion a good plan is to carefully observe and note some of the best roofs in the country, and, at all events for the larger and more important classes, our large railway stations are excellent media for observation.—H. LLSLAND.——*A.*—If the truss is properly proportioned and jointed, no increased strength or stiffness would be gained by using flat bars for the tension members. These are to act as *ties* only in a well-framed truss, and a round bar is more to depend upon than flat, and will take a neater eye. The best possible form for the rafters is T-iron, and for the braces an I section formed of two parallel pieces of plate with distance pieces of pipe having a rivet through each, holding the plates to the distance pieces. The incidence of the loads depends entirely upon the arrangement of purlins adopted. The simplest method is to bring the load directly on three points on each side of the roof—viz., on the ridge, purlin, and pole-plate, placing the purlin half-way down the rafter and over the brace, with common rafters spanning these and bearing the roof covering. The other method is to have a succession of small purlins (or "horizontal rafters") all the way up the principal rafter. In the latter case, the portion of rafter from pole-plate to brace is to be considered as a separate beam with evenly-distributed load, and bringing, therefore, half the weight it bears on the pole-plate and half on the brace. The portion from brace to ridge is to be treated in the same way. Therefore in either case the whole load on one side of the roof comes on ridge, purlin, and pole-plate, but in the latter case the rafter must act as a girder as well as a strut. The compression in the top flange of the rafter, caused by bending strain, must, therefore, be added to that due to its acting as a strut when the scantlings of the rafter are calculated. The weight of a Fink truss, ¼ pitch and 40ft. span, with principals 6ft. apart, should not exceed [illegible]. With the high pitch adopted this would probably be even less. The weight of [illegible] may be considered, without serious error, evenly distributed across the whole span, and may be expressed as so much load per square foot of covered area. The snow pressure may be neglected, as it is absolutely necessary to calculate for the wind pressure, which is a much greater factor, and with a high wind the snow would be carried away. The wind pressure normal to the surface of the roof (31° pitch) would be about 34lb. per sq. ft., assuming a wind force of 50lb. If the roof could be reduced to one-fifth pitch, or 21½° (as for corrugated iron it might be with advantage, this normal wind pressure would be reduced to 25lb. per sq. ft. of roof. The wind pressure adopted may be added to the permanent load, and then Clerk-Maxwell's diagrams will solve the rest. Stress on wrought-iron members to be 5 tons in tension and 4 tons in compression.—T. J. B.

DYNAMO MACHINE.—I have a dynamo of the Gramme pattern of the following dimensions:—Size of armature, 4in. diameter, containing 12 coils ½in. wide by 2in. long; weight of No. 20 wire on field magnets 6lb. (double cotton covered); weight of No. 20 wire on armature 1lb. (double cotton covered). What would be the proper speed to run? What the pressure in volts? And how many ampères? What lamps would be best to use, and how many?—ELECTRICAL ENGINEER.——*A.*—The resistance of the magnet coils is not sufficient in proportion to the armature resistance. You should re-wind the magnets with 10lb. of No. 22 double-cotton-covered wire. This is for a shunt machine, which is best for incandescent lamps. Speed, about 1200 revolutions per minute; but you will have to ascertain this by trying the lamps on. This machine should give 40 to 42 volts and 4 ampères. Edison and Swan incandescent lamps are about the best to use. The number of lamps it will light will be two 16C.P. or four 8C.P.—T. MANWARING.

CASTING SASH WEIGHTS.—Would any reader favour me with information relating to the casting of sash weights in chills. It seems to me that it requires a very expensive plant, and is beset with many difficulties, such as (1) the chill, if made of cast iron and to receive a large number of weights, must be very weighty and cumbersome and not easy of manipulation, therefore incurring great loss of time; (2) the faces require planing and careful adjustment; (3) does not the coreing become awkward? (4) the chill must burn away by constant use; (5) a large quantity of useful metal is lying idle when the chills are not in use. I shall be pleased to receive any information as to a cheaper way of constructing chills, etc.—C. R. ROBERTS.——*A.*—Cast them from a pattern in ordinary sand moulds. If this is not suitable, write again.—T. MANWARING.

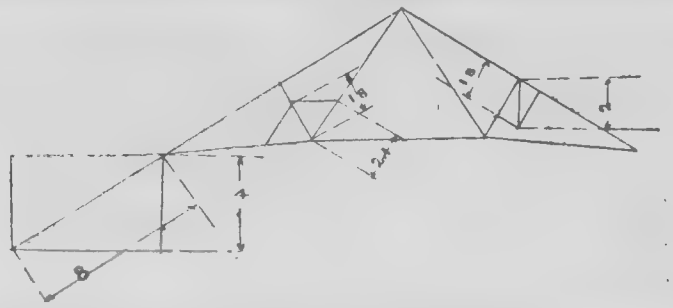


DIAGRAM 2.

Latest Inventions.

APPLICATIONS FOR LETTERS PATENT.

When Patents have been "communicated," the name of the communicating party is printed in italics.

Where complete specification accompanies application, an asterisk is suffixed.

21st October, 1892.

19,025 ELECTRICITY METERS. A Wright.

19,026 CYLINDRICAL CORRUGATED SHEET METAL AIR PIPE OR TROUGH. J H Plant.

19,027 ENGINES FOR PROPELLING SHIPS OF WAR. R B Smith.

19,034 CRANES. A Grafton.

19,041 BEARINGS and MEANS of LUBRICATING AXLES. W J Brewer.

19,042 BRICK and TILE MAKING MACHINES. W F Butler and C Mason.

19,043 WILLEY'S AUTOMATIC HAULAGE CLIP. J Willey.

19,045 APPARATUS for CONVERTING HEAT INTO WORK. J H Parkinson.

19,049 STEAM ENGINES. W Craven.

19,054 PNEUMATIC MOTOR ENGINE.* E Mein.
19,055 DETONATING FOG SIGNAL for RAILWAYS. J Pickering.
19,059 APPARATUS for FILTERING FEED-WATER or FLUID for STEAM BOILERS.* W B Basset.
19,061 ELECTRIC RAILWAY SYSTEMS.* W E Irish.
19,062 APPARATUS for ENABLING ELECTRIC CURRENT to be DERIVED from an INCANDESCENT LAMP HOLDER and CONDUCTED to a LAMP a DISTANCE THEREFROM. S A Hunter.
19,063 TUBE-WELL APPARATUS.* A J Boult. (*L B Donkers*, Belgium.)
19,068 HAND LAMP, COMMONLY KNOWN as ENGINEER'S LAMP.* W Rowe.
19,070 LOCOMOTIVE ENGINES for STREET TRAMWAYS. O Imray. (*C Lührig*, Germany.)
19,074 RAIL or TRAM PERMANENT WAY. F P A Victor and H A Haarmann.
19,076 MICROPHONE CARBONS. G S Hooker.
19,077 CONDUITS for ELECTRIC CABLES. J Aird.
19,078 APPARATUS for the PRODUCTION of OXYGEN and NITROGEN from ATMOSPHERIC AIR. L Chapman
19,081 CASES of ROCKET and LIFE-BUOY LINES. W Schermuly and E B Jones.
19,084 AUTOMATIC COUPLING for RAILWAY VEHICLES. T Cooper.

25th October, 1892.

19,092 FLUE TUBES for STEAM GENERATORS. T K Barclay.
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FRIDAY, NOVEMBER 18TH, 1892.

The Generation and Distribution of Power.

AT a meeting of the Manchester Association of Engineers, held on Saturday last, Mr. B. H. Thwaite read a very exhaustive paper dealing with the possibilities of generating power at central stations located in the coalfields, and distributing it to the various industrial centres by the agency of electricity. Mr. Thwaite brought forward many arguments in support of the project, and he certainly made out a good case, whether regarded from a financial, industrial, hygienic, or thermodynamic standpoint. The advantages to small power users of a supply of electrical energy were summed up as follows:—No heavy and costly foundation; no expensive shafting required; no smoke nuisance; no ashes or removal by cartage; cost of water and coal avoided; no danger from explosion; full power at any moment, which has only to be paid for in proportion to amount used. After touching upon the losses incurred by the transmission of power by shafting, belts, etc., three projects for the electrical transmission of energy generated in the coalfields were described. The first was a scheme for transmitting power from the South Yorkshire coalfield to London, serving *en route* such large towns as Derby, Nottingham, Leicester, Northampton, and Bedford. The other two projects are for supplying electromotive force to the principal industrial centres of Lancashire and Yorkshire. For the Yorkshire one the central generating station is located near Barnsley, and will serve the industrial areas between Chesterfield and Sheffield in the south and Leeds in the north, serving the Batley and Dewsbury district *en route*. A branch trunk line serves Huddersfield, Halifax, and Bradford, and their adjoining industrial areas. The Lancashire project generating station is located near Wigan, one trunk line serving Bolton, Bury, Heywood, and Rochdale, while a loop line will serve Oldham, Stockport, Macclesfield, and Manchester. Another trunk line will serve Blackburn, Preston, and Clitheroe. A loop-line branch will serve Accrington, Burnley, and the Rossendale and Haslingden Valleys. A trunk line passing south from the station will supply St. Helens, Warrington, Runcorn, and Widnes, and a loop line will continue along the Ship Canal to serve the future industrial area of progressive Lancashire. Regarding the scheme from a financial aspect, Mr. Thwaite shows that by employing gas engines worked by gas generated on the spot a 10,000H.P. plant in the South Yorkshire coalfield would enable power to be distributed at a cost of 1·34d. per kilowatt hour, and this could, therefore, be sold at, say, 2½d. per kilowatt hour, as against 6d. to 8d. at present charged in the metropolis. As we have said, the whole subject was treated very exhaustively, and although, in matters of detail, cost, etc., the views advanced admit of much discussion, yet it cannot be disputed that the project has much to recommend it. In our opinion, some such scheme must inevitably displace our present isolated power-generating system in the future. How near that future is we cannot pretend to say.

The Tramway Problem in Coventry.

COVENTRY is in a dilemma. Horse tramcars are unknown, and the steam cars which used to snort along the streets have vanished, whilst "sent to Coventry" is experienced by the man who built the first electric tramway on the overhead system in this country. It is not our purpose to inquire into the reasons which led to the withdrawal of the steam cars; suffice it to say that they did not fulfil public requirements, and no one grumbled when the order was issued that the line in the centre of the town would no longer be operated by the steam cars. Mr. Graff-Baker, with his characteristic enterprise, then came along and acquired the tramway by purchase. This was a bold step to take by the promoter of the Thomson-Houston system of electric traction in the United Kingdom—so bold, indeed, that one cannot help but admire the smartness he displayed in the matter before seeking to ascertain the attitude which the local authorities might adopt when he approached them on the subject of employing electricity as the motive power. He offered to sell the line to the Corporation and then to take it back again on lease; but this proposal was rejected. Now, however, that Mr. Graff-Baker has asked for running powers for 21 years, provided permission is given for the introduction of electric cars, the Corporation still hesitate, and the promoter with the line remaining on his hands fully understands being "sent to Coventry." Thus the matter stands at present. It appears that an underground-conductor system might be favoured, but the overhead method is not regarded as pleasing. How the matter will terminate remains to be seen; in the meantime, Coventry is deprived of its tramcars, and Mr. Graff-Baker is in possession of a line which he is not permitted to work.

The Hydrophone.

EXPERIMENTS have lately been made at Portsmouth with an ingenious electrical instrument called the hydrophone, and which has for its object the defence of roadsteads, anchorages, etc., by giving warning of the approach of torpedo boats or other hostile vessels. The instrument, which is the invention of Captain M'Evoy, consists of two parts. One part is placed at the bottom of the water outside the anchorage or minefield at a depth of from 5 to 15 fathoms, and the other is fixed in a station on the shore, and the two are electrically connected by cable at distances of from one to five miles. In the present instance the instrument was sunk in 7 fathoms and about 300 yards off Fort Gilkicker. The submerged part consists of a bell-shaped iron case, ¼in. thick, 20in. in height and extreme diameter, and weighing about 340lb. At the top is fitted a sensitive vibrator or diaphragm enclosed in a copper box. It is formed of a plate of ebonite with carbon attachments, and when the case is submerged the delicate mechanism is kept clear of the water by means of the column of compressed air, which is enclosed as in a diving-bell. No sooner does a torpedo boat approach within a radius of half-a-mile, or a man-of-war within a mile, than the pulsations of her propellers produce a vibratory movement inside the case. These vibrations are transmitted to the station on shore in the following manner:—The electric current from the land battery passes through the vibrating mechanism and also through the apparatus on the shore, in the circuit of which is placed an instrument named a kinesiscope, which is somewhat of the nature of the galvanometer. By means of this the perturbations in the water are communicated to a needle flickering in a graduated arc, and when the oscillations become pronounced the needle is clutched by a magnet at the end of the arc. Contact is thus made, and the vibrations in the submerged case are made visible and audible by means of flashing lights, the firing of a gun, and the ringing of a bell. Telephonic signals are also transmitted through the same current. The idea is that for coast defence a number of hydrophones should be sunk in the approaches to a port or dockyard, and connected with a central station, and that as soon as one of them has given its warning of the neighbourhood of an enemy, the information should be communicated to the threatened point by independent cables.

An Electric Tramway in Bilbao.

SLOWLY but surely the American overhead system of collecting current for electric tramways is gaining ground on the European continent. The latest instance is in the case of the Bilbao-Santuce Tramway Company, in Spain, which has decided to abandon all its horse cars, and to adopt in their place electricity as the motive power. Trials with electric cars had already been made by one firm on behalf of the tramway company, but they were discontinued. Now, however, the Thomson-Houston Company have been commissioned to convert the line to their well-known system. The line, which is about nine miles in length, starts at Bilbao and terminates on the coast at Santuce, passing through one of the most populous districts. The stock will comprise 12 cars, each fitted with two electric motors of 15H.P. The generating station, situated about half-way along the line of route, will contain three four-pole dynamos, giving each 100,000 watts. It is expected that the line will be inaugurated next April.

Shipbuilding on the Humber.

THE returns of the shipbuilding firms on the Humber for the year now closing show a decrease on last year's output. Earle's Shipbuilding and Engineering Company have launched 13 vessels, of a total tonnage of 10,683 tons, as compared with 21 vessels, 11,789 tons, in 1891; and Messrs. Cochrane and Cooper, of Reverley, built 13 vessels, in all 1058 tons, their output in 1891 being 25 vessels, 3782 tons. The vessels built in 1892 are as follow:—Earle's Company: The war vessel "St. George," 7700 tons, for the British Government; the screw steamers "Victoria" 688 tons, "Sardius" 184 tons, and "Bruno" 840 tons, for Hull owners; the steam trawlers "Kymrie" 126 tons, "Lyric" 126 tons, and "Josephine" 157 tons, all for Grimsby owners; "Grampus" 160 tons, "Porpoise" 160 tons, "Walrus" 160 tons, and "Seal" 160 tons, for Boston owners; the steam yachts "Queen" 190 tons, and "F. B. Grotrian" 32 tons. Messrs. Cochrane and Cooper: The steam trawlers "Africa" and "America," each 160 tons; "Australia" and "Canada," 138 tons each; "Hugelia," 141 tons; "Rupert" and "Romeo," 108 tons each; the steamers "Tubular," 105 tons, and "White Rose"; two iron lighters, and two water boats for deck service.

Development of the Machinery of Atlantic Liners.

AT a meeting of the Liverpool Engineering Society held at the Royal Institution, Colquitt-street, on the 9th inst., under the presidency of Mr. R. E. Johnston, a paper was read on "The Development of the Machinery of Atlantic Liners," by Mr. Arthur J. Maginnis, M. Inst. N.A. In the course of his paper Mr. Maginnis said:—Owing to the great interest centred in the coming of the vessels now under construction for the "Atlantic ferry," the development of the machinery used and in use on Atlantic liners at the present time is not without interest. The first vessel, the "Savanah," in 1819, indicated 90H.P., and represented 1850 displacement tons propelled six knots with 0·0048I.H.P. to the ton of displacement; the next vessels, such as the "Royal William," "Sirius," and others, in 1838, represented 1980 displacement tons propelled eight knots with 0·03I.H.P. to the displacement tons. These figures were gradually changed by continuous improvements until, in 1870, the White Star liner "Baltic" represented 7100 tons displacement propelled 13½ knots with 0·4I.H.P. to the displacement tons, and in 1881 the Cunard "Servia" represented 12,300 tons displacement propelled 17 knots with 1I.H.P. to the displacement tons; the coming Cunard "Campania" being estimated to represent 20,000 tons displacement propelled 22 knots with 15I.H.P. to the displacement tons. Commencing with the side lever engines for paddle-wheel vessels, the various types of machinery of this class were described, and their more important features, weights, and proportions pointed out, followed by extensive descriptions of the screw propelling machinery, which was fully entered into, the various forms of beam, steeple, oscillating, and other geared screw engines being described, and also the various types of direct-acting engines, such as the trunk, the inverted or tilt hammer, and the evolution to compound triple-expansion engines, the marked economy and increasing sizes of each period being noted. A general description of the boilers which were used was given, commencing with the old flat-flue system, then the dry and wet bottom for single-expansion engine type, which have now given place to the cylindrical form, with internal furnaces, either corrugated or ribbed. The important matter of the weight and thickness of the boiler shells, as at present constructed, was noticed, and it was suggested that the time had arrived when the Board of Trade and other classification authorities should follow the excellent example set by the Admiralty, and allow of the hydraulic test being reduced to 90lb. over the working pressure, instead of double; that especially when the excellent material and workmanship are borne in mind, together with the fact that no boiler shells have ever failed under the new Admiralty rule. If this were done a very substantial reduction could be gained in the enormous weight absorbed by the boilers alone of a modern liner, the coming Cunarders being estimated to have about 1200 tons of weight absorbed by the boilers alone. The discussion of the paper was adjourned to the 23rd inst.

THE Old Level Ironworks, Brierley Hill, Birmingham, lately carried on by Mr. Henry Hall, have been bought by Mr. Henry Mantle, jun., whose father has been manager of the works. He has acquired them as a going concern.

The Under-type Stationary Engine.—XX.

THIS week we give drawings and a table of dimensions of small sized locomotive multitubular boilers from 4 to 10H.P. inclusive, suitable for the single-cylinder under-type or separate engines, as per the dimensions contained in Article No. IX., MECHANICAL WORLD, January 8, 1892. Fig. 33 gives half-end elevation and half-transverse section through firebox, and Fig. 34 a longitudinal section of locomotive boiler.

The sizes of the fireboxes are suitable for coal burning; larger boxes are adopted for wood burning. From the illustration it will be seen that the boiler is of the raised firebox type, which gives additional steam space over the firebox. It has its advantages for engines placed on the top of the boiler, the cylinder receiving its steam from the firebox end. In the under-type engine the steam pipe is usually at the smokebox end; but the steam should be collected from the firebox end, no matter where the stop valve happens to be fixed. The shell plates are of Siemens-Martin steel. The firebox plates are of Lowmoor or Bowling iron. The longitudinal and transverse seams are single riveted with $\frac{11}{16}$in. mild steel rivets, and $1\frac{3}{8}$in. pitch. All the flat surfaces of the firebox have the stays 5in. pitch. The firebox roof stays are placed longitudinally, the bolts are 6in. centres, and the washers allow a space of $1\frac{1}{2}$in. between the firebox top and the roofing bars, which admits of the scale being scraped off. The scrapers are worked from the manhole. The firebox bottom frame is made of $3\times3\times\frac{7}{16}$in. Z-iron, which we do not recommend, as the top row of rivets in the ring is quite inaccessible. Moreover, the downward pressure, tending to force the firebox out, throws a severe strain on a weak connection. A couple of sling stays might be used to remedy this fault. These Z-iron frames are often deeply corroded, the corners being quickly eaten away. The solid frame is a better job. This will be referred to further on. The firehole ring is made of a solid bar, as shown. It is a usual plan to dish the firebox plate slightly, so that the firehole ring may be made of 2in. square iron. This is a sounder plan than the one shown. A strengthening ring $\frac{5}{8}$in. thick is riveted round the manhole with a double row of rivets. Longitudinal stays are usually adopted in this type of boiler for the purpose of strengthening the front plate of the firebox and the smokebox tube-plate, but they also stiffen the flanged saddle plate, which is a weak part of the boiler. In this instance, three longitudinal stays are shown, having jaws and pins for attaching to gusset stay at the firebox end, and two nuts at the smokebox tube-plate end. Two lifting rings are required, as shown on Messrs. Ruston, Proctor and Co.'s engine in Article No. XVI. The chimney base is made of cast iron.

(To be continued.)

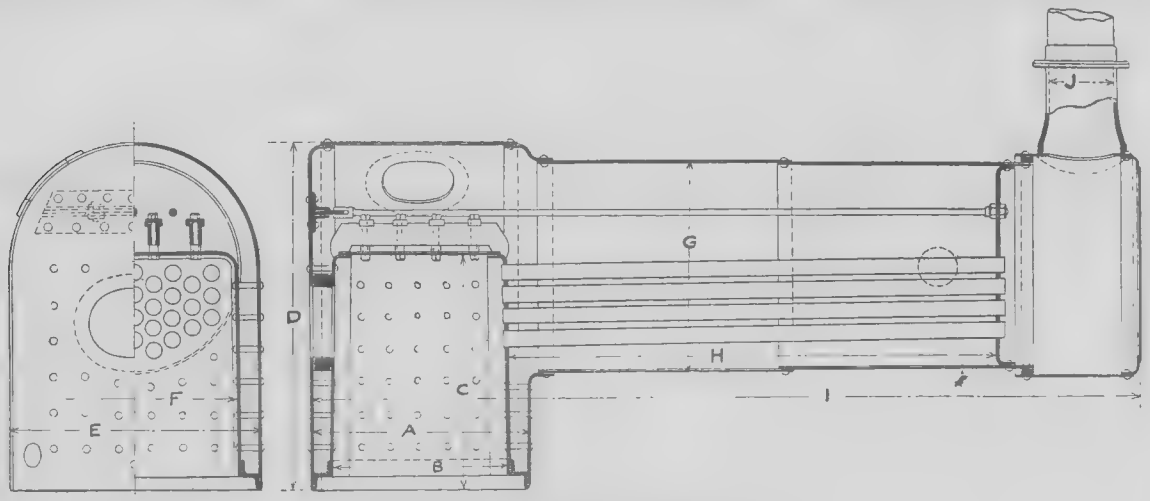


FIG. 33. THE UNDER-TYPE STATIONARY ENGINE.—FIG. 34.

TABLE OF DIMENSIONS OF LOCOMOTIVE BOILERS.

Nominal H.P.	—	4	5	6	7	8	10
Working steam pressure, in lb.	—	80	80	80	80	80	80
Hydraulic test pressure, in lb.	—	160	160	160	160	160	160
Length of outside firebox, in ft. and in.	A	2 8	2 8	2 9	2 9	2 10	3 0
Length of inside firebox, in ft. and in.	B	2 0½	2 0½	2 1½	2 1½	2 2½	2 4½
Height of inside firebox, in ft. and in.	C	2 6	2 6	2 8	2 9	2 9	2 10
Height of outside firebox, in ft. and in.	D	3 9	3 9	4 0	4 3	4 3	4 6
Width of outside firebox, in ft. and in.	E	2 9	2 9	3 0	3 0	3 2	3 6
Width of inside firebox, in ft. and in.	F	2 1½	2 1½	2 4½	2 4½	2 6½	2 10½
Diameter of barrel, in ft. and in.	G	2 3	2 3	2 6	2 6	2 8	3 0
Length between tube-plates, in ft. and in.	H	5 3	5 9	5 9	6 0	6 0	6 6
Width of smokebox, in ft. and in.	—	1 3	1 3	1 5	1 5	1 5	1 7
Diameter of smokebox, in ft. and in.	—	2 6	2 6	2 9	2 9	2 11	3 3
Length of boiler over all, in ft. and in.	I	9 2	9 8	9 11	10 2	10 3	11 1
Diameter of chimney, in in.	J	9	9	10	10	10	12
Number of tubes	—	18	21	21	27	32	36
Diameter of tubes, in in.	—	2½	2½	2½	2½	2½	2½
Firebox heating surface, in sq. ft.	—	23·40	23·40	27·20	28·50	29·84	32·51
Tube heating surface, in sq. ft.	—	62·10	78·96	90·24	105·84	125·56	153·00
Total heating surface, in sq. ft.	—	85·50	102·36	117·44	134·34	155·40	185·51
Grate area, in sq. ft.	—	4·28	4·28	5·21	5·21	5·53	6·74
Size of firehole, in in.	—	8×10	8×10	10×12	10×12	10×12	10×10
Size of manholes, in in.	—	10×13	10×13	10×13	10×13	10×13	10×13
Size of mudholes, in in.	—	2½×3½	2½×3½	2¾×3¼	2¾×3¾	2¾×3¾	2¾×3¾
Thickness of plates, in in.:—							
Firebox shell, side and top	—	3/8	3/8	3/8	3/8	3/8	3/8
Firebox shell, front and back	—	5/16	5/16	5/16	5/16	5/16	5/16
Barrel	—	5/16	5/16	5/16	5/16	5/16	5/16
Inside firebox, sides and front end	—	5/16	5/16	5/16	5/16	5/16	5/16
Firebox and smokebox tube-plates	—	1/2	1/2	1/2	5/8	5/8	5/8
Smokebox barrel	—	5/16	5/16	5/16	5/16	5/16	5/16
Chimney	—	1/8	1/8	1/8	1/8	1/8	1/8

London Association of Foremen Engineers and Draughtsmen.

THE usual monthly meeting of this association was held in the K. room, Cannon-street Hotel, on Saturday, the 5th instant, at 7 p.m., the president (Mr. Garnish) being in the chair, and past president Mr. Bartle in the deputy-chair. Mr. Wilkinson, chief draughtsman to Clarke, Bunnett and Co. Limited, and Mr. J. H. Grey, foreman brassfounder to Messrs. Maudsley, Sons and Field Limited, were elected as ordinary members, and other general business was transacted, after which a paper was read by Mr. F. Korb on "The Manufacture of Sound Steel Ingots."

Mr. Korb described the properties and mode of production of good steel ingots and castings, and exhibited a number of samples illustrative of his remarks.

An interesting discussion took place, in the course of which Mr. Coates stated that he had great trouble with milling cutters until he got some Styrian steel, which had turned out the best he had ever tried for that purpose, and also for tools generally. His experience, however, taught him not to give high-class steel to a blacksmith to forge unless he could afford to be present during the whole time of the forging, and he preferred to have it shaped by machine, and found he now had not more than one per cent. failures in cutters. Mr. Lowe mentioned the excellent results which had been obtained some years ago from steel projectiles hardened by hydraulic pressure, as compared with similar projectiles hardened in water, and thought it would be to the advantage of engineers generally if they would harden tools and other things under hydraulic pressure, as he had found the most excellent results from that system.

A vote of thanks was awarded to Mr. Korb for his excellent and instructive paper, and the meeting closed.

Engineering Pattern Making.

BY A FOREMAN.

XXVII.

IT frequently occurs in the construction of a building that the ordinary stock bends are found unsuitable through not having sufficient "set-off" or crank to clear a moulding or other projection, and as it is desirable to maintain the style and thickness throughout the work, a special bend has to be made, and this is done as follows:

Fig. 173 shows an elbow with socket at one end, to make which three strickles will be required, one with a pin to work in a hole and on the surface of the board, and so form the radial portion of the bend from A to B at Fig. 173. Strickle No. 2 will be similar to that shown at Fig. 168, and arranged with two thicknesses of sheet zinc; with this will be formed the straight portion of the elbow C and D. The third strickle is required to form a straight piece of moulding, which eventually becomes the socket or part marked S. After the several sections have been run up, left to dry, and then varnished, they are passed on to the pattern moulder, who makes a sufficient number of "compo." metal castings to make up the two halves of a pattern. The separate pieces are then connected by the pattern maker with a soldering iron and some soft solder, files and "floats" being used to remove any roughness and give a general finish to the pattern throughout.

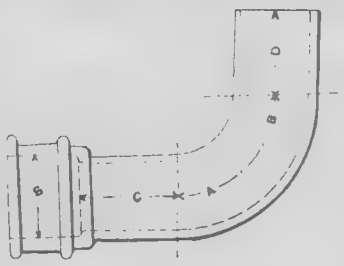


FIG. 173.

Fig. 174, which at the beginning is a straight piece of moulding, is bent to fit the outside of the pipe at C, and then soldered to the same, the narrow belt which runs on the underside of this piece forming the clearance in the pipe socket; small "nibs" or projections on the edges, as in Fig. 165, keep the half-patterns in relative position; "lugs" or ears are also attached to the pattern, and whether they must be fast or loose is dependent upon their position in the mould. If in line or at right angles to the joint of the pattern, they may be fast; but in any other position, they must be loose, and can be set with a wire pin or skewer through each one upon each half-pattern.

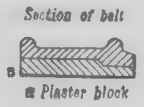


FIG. 174.

The making of this class of pipe from a metal pattern is worth description, as the making of dry sand cores, as in an ordinary steam-pipe casting, is entirely done away with, and this mode of procedure may be adopted in many cases where it recommends itself to either pattern maker or moulder. Where numbers of castings of elbow pipes are required, it is usual to have a couple of metal patterns and to work the two together in one moulding box, though a "double" iron is then necessary to support the green sand forming the inside of the pipe.

It will be better to first take a single elbow or bend to illustrate the process, such as is shown at Fig. 175.

A core iron of the ordinary section, and in which are cast several pieces of wrought-iron rod, is made in open sand for each half of the pattern, and about 4in. longer at each end. The moulding of the pattern

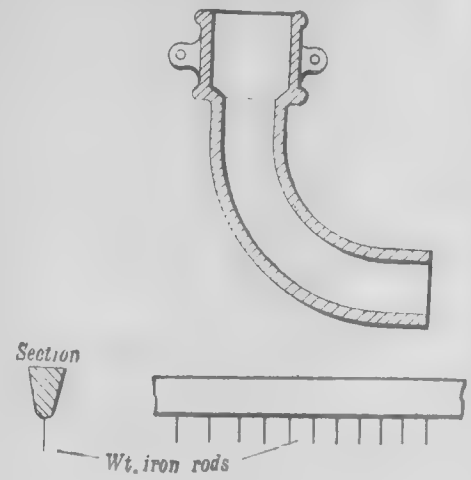
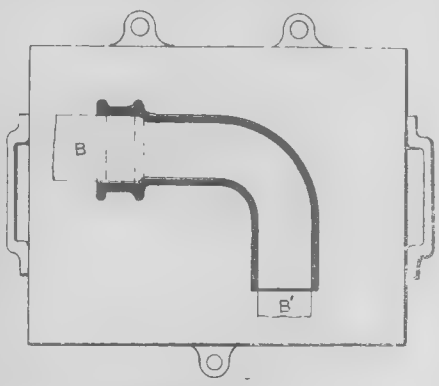


FIG. 175.

may then be proceeded with as follows:—One half of the pattern is set joint side down on a faceboard, with the usual layer of facing sand over it, the rest of the box being rammed up with black sand. The box is then turned over and a bearing for the core is cut out 4in. or 5in.



B and B' bearings for core

FIG. 176.

beyond the end of the pattern with a good taper at the ends, and corresponding in diameter to the inside of the pattern (see Fig. 176). This portion of the mould, together with the face, is then freely sprinkled with parting sand, which is then blown off, and the core of the pipe is

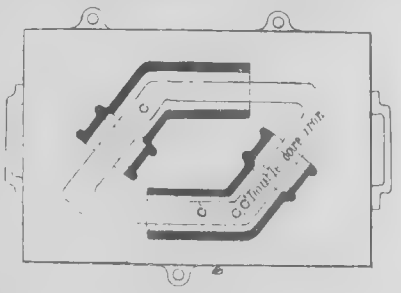


FIG. 177.

formed by ramming up the inside of the pattern and inserting the core iron about half way. The remaining portion is then rammed up to the joint line of the box, levelled off, and the other half of the pattern put on the one already moulded. The top part box is then put on, rammed

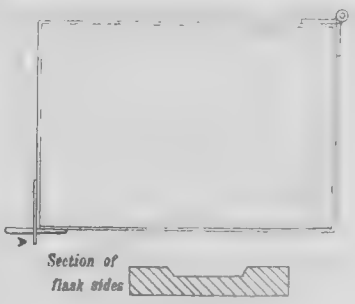


FIG. 178.

up and then over to allow the green-sand core to be formed, as described, for the other half of the pattern, and to allow of its being levelled off to the joint line which has been formed round the outside of the pattern. The cores are now ready for taking out, and it will be obvious that this must be done before the halves of the pattern can be withdrawn.

The metal pattern is next lifted, the cores set back in position, being supported at the ends in the bearings and further sustained by a "chaplet" set under the core midway between the bearings.

In Fig. 177 is shown the "double" iron previously mentioned in connection with the use of two metal patterns, and Fig. 178 illustrates a form of moulding box known as a "snap flask," which is commonly made of hard wood and hinged at one corner, opening diagonally and fastened by means of two iron wedges at the corner A, and by reference to the section it will be seen that the sand is firmly held by filling the recesses in the sides and ends. The use of these boxes is limited, and only applicable to light castings where little pressure is exerted. For such work they are very useful; and further, they can be released after a few minutes without disturbing the sand forming the mould, so that a few of these boxes can be made to serve for a large number of moulds without "knocking out," as in the ordinary moulding box. Sufficient examples have been given in the use of plaster of Paris, and it is now left to our readers to use it at their discretion under any conditions that may be desirable, either to form an entire pattern or part of a composite one.

(To be continued.)

Hydraulic Machinery.—XI.

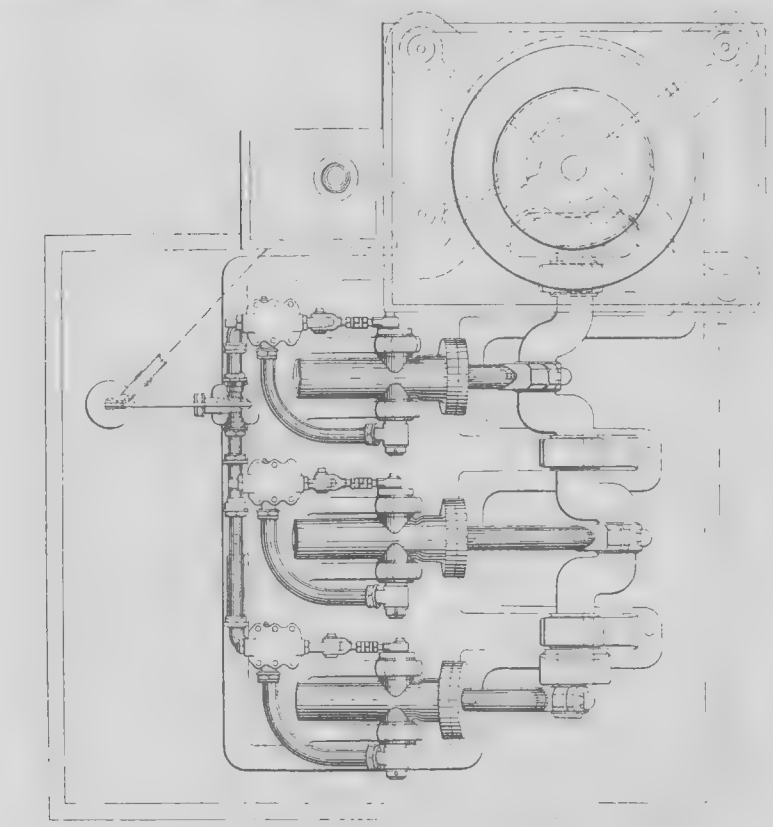
It is frequently necessary to obtain a rotary motion from hydraulic power, and several types of engines have been designed to accomplish it. The most common is the three-cylinder single-acting oscillating engine shown in Fig. 32. The rams are single-acting and are fitted with gun-metal steps and keep to connect direct on to the shaft. They are turned the full length and fit into a cast-iron cylinder having a stuffing box and gland of the usual type, and carried on trunnion joints as shown, so as to be free to oscillate. The valves are of the slide-valve type, ordinary double-ported, similar to Fig. 12 in Article VI., and are worked by means of a small disc and pin fixed to the trunnion of the cylinder. The opposite trunnion has an oscillating joint for conveying the water to and from the cylinder. This engine is shown connected up to a capstan as used for hauling purposes in railway goods yards, and is capable of exerting a pull of one ton on the rope at a speed of 120ft. per minute. Fig. 33 shows the Armstrong turnover capstan and engine as used for the same purpose. The engine has two double-acting oscillating cylinders, with special trunnion working valves, as shown in Fig. 34. The valve is arranged to give a constant pressure to the front of the cylinder, the back of the cylinder receiving pressure and exhausting in the usual way. The advantage of the turnover arrangement is the facility with which repairs can be executed or the machinery examined for cleaning and oiling, and also the small space occupied.

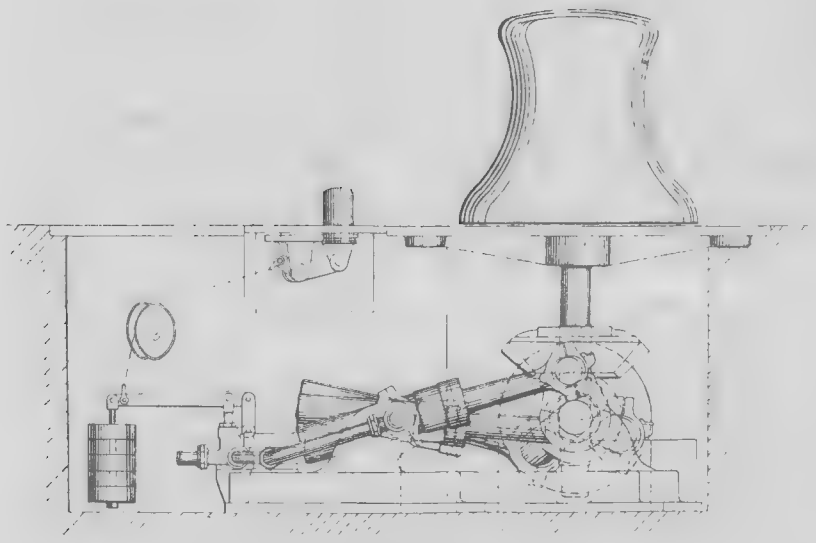
In the Brotherhood three-cylinder capstan and engine the cylinders act direct on to the capstan shaft, without the intervention of gearing. The cylinders are bored and small pistons are fitted, short connecting rods being used to connect the pistons to the shaft. The valve is of the slide-valve type worked by an eccentric cam turned on the end of the shaft. Capstans and engines are also used for exerting a large hauling power, as required for hauling ships into docks, the usual size being 2½ and 5 tons for the merchant service, and for the navy up to 12 tons, on the hauling rope. The ship capstan is usually made to run loose on the spindle, being driven by pawls, and has holes for handspokes round the head for use when the hydraulic power is not available. The double power is obtained by gearing and clutches, as in crane work. The types of engines described above are applicable for any purpose where rotary motion is wanted, as for band machinery in a grain warehouse, elevators, heavy-geared cranes, geared gate machines, etc., etc.

The efficiency of hydraulic rotary engines is very low, being only 0·6 to 0·7, and is accounted for from the fact that water is practically incompressible. Another disadvantage is, that no matter what power may be required, the same amount of water is used. They are, therefore, only economical when working at their full capacity. Mr. Hastie has patented a most ingenious arrangement, whereby the throw of the crank is varied automatically to suit the work done, which is described in a paper read before the Institution of Mechanical Engineers.

In hauling trucks the power required has been found to be about 30lb. to 35lb. per ton on a level rail. The velocity of the water through the working valves should not exceed 25ft. to 30ft. per second. Fig. 35 shows a guide capstan or snatch head used in conjunction with the above engines.

(To be continued.)





Hydraulic Machinery.—Fig. 32.

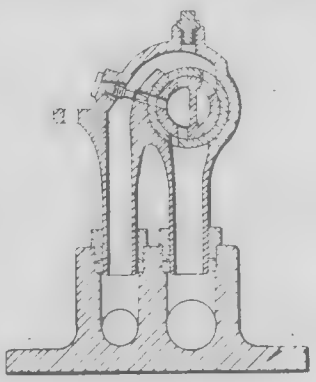


Fig. 34.

Underground Haulage by Electric Locomotives.*

The drawbacks of chain haulage are that:—The first cost is high; they encumber the rolley-way, so that an accident may interrupt the output; and they generally require a double line of way, thus forming an obstacle to the passing of the men. Electric haulage has made great progress during the last few years. The installation is very simple; the way may be single; and, in case of breakdown, the locomotive may be at once superseded by horses, kept on the spot for other work. While the electric locomotive is more economical than horse traction, it conveys the men to their working places without loss of time or fatiguing them, so that coal may be got within a considerable radius from the shaft.

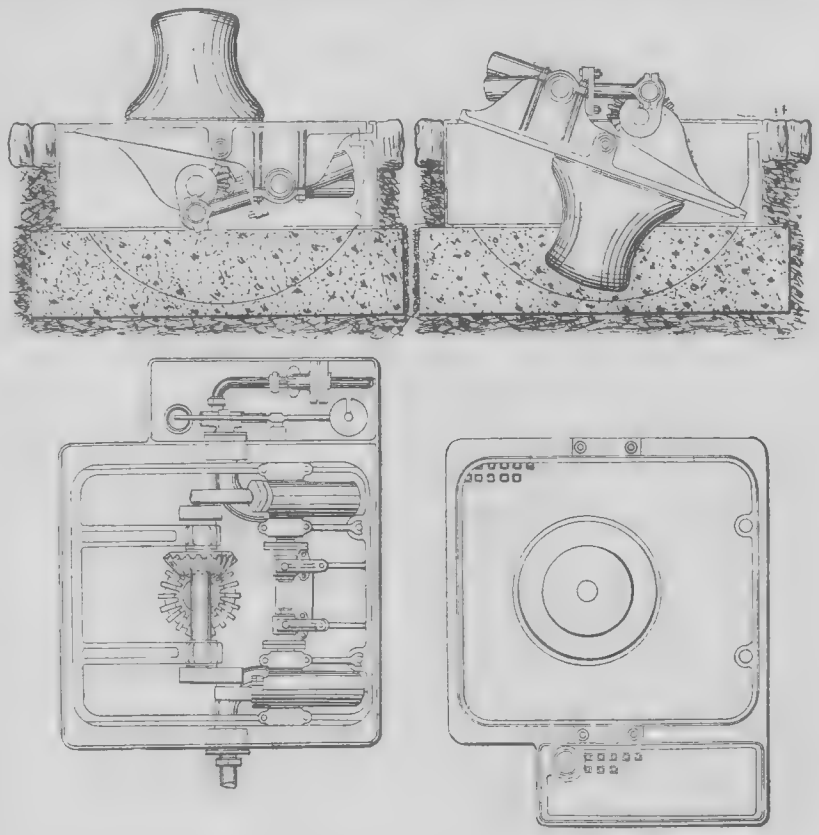
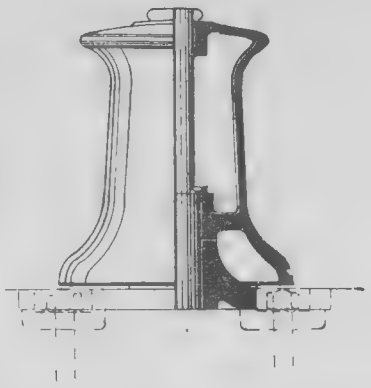


Fig. 33.



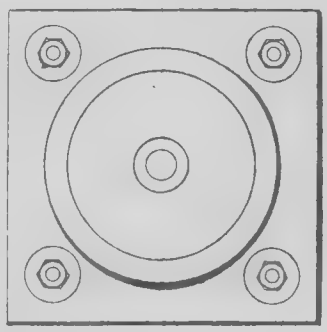


Fig. 35.

A visit to the Zaukeroda Mine, in Saxony, decided M. Rambeaux, administrateur délégué (managing director) of the Marles Colliery Company, who was already favourable to the system, to make an actual trial, though on as reduced a scale as possible. The locomotive was designed by M. Neu, engineer to the Edison Company, in conjunction with the Marles engineers.

The installation is capable of supplying current to two locomotives, one only of which was made first so as to permit of modifications, suggested by practice, being

* Abstract of paper by Clément Baily, engineer at the Marles Collieries, read before the Charleroi Committee of the Hainaut Engineers.

The Cleveland ironmasters' returns for October show an increase of stock of Cleveland iron of 16,914 tons, compared with 7000 tons increase in September and 5000 tons decrease in August. The production of 237,000 tons, one of the largest on record, is about equally divided between Cleveland and steel-making iron, but five more furnaces are blowing on the latter and one less on Cleveland pig metal. The total stock is 70,183 tons, 24,000 tons increase in two months. The large increase is disappointing.

Messrs. J. and W. Weems, engineers, Johnstone, have just had delivered from Messrs. Fullerton, Craig and Co., a casting of a cylinder weighing 21 tons, which forms a section of a lead press which weighs over 60 tons when completed. This is the largest lead-pipe press ever made by this firm, and is used for the enclosing of cable and all classes of electric wires in the lead pipe, the work being done simultaneously.

ntroduced into the second. Each locomotive was to exert a useful work of 10H.P.; the motor was to give out 70 per cent. of the power available on the shaft of the generating dynamo; and each locomotive was to extend 30 ampères, at a tension of 100 volts, all of which conditions were realised. The installation for haulage, and also lighting, was applied to pit No. 4, the north rolley-way of which is admirably adapted for haulage, while the conditions were unfavourable in the south rolley-way, so that a good test of the system was afforded.

The engine, with cylinder of 40cm. (16in.) diameter, and stroke double that figure, with expansion variable by the regulator, makes 65 revolutions and drives the dynamo by a belt, the ratio of the pulleys being 12:95, so that the dynamo makes 840 revolutions. The covered conductors, formed of copper ropes 9mm. in diameter, are carried by porcelain insulators every 30 metres. The conductors are led to a switch-board which permits of sending the current to the north and south rolley-ways, the conductors in which consist of light flange rails hung upon the roof and insulated by rubber washers.

The locomotive consists of a dynamo in series, with a power of 15,000 watts, mounted on a wrought-iron underframe with two axles, the motion of which it transmits by an intermediate shaft and gear, the dynamo shaft being parallel with the rails. The current is taken from the conductors by two small trucks drawn along by the locomotive; and a rheostat in the circuit, worked by hand-wheel, permits a variable excitation of the magnetic field of the dynamo, so that the electromotive force and the electric power of the engine, which is well under control, may be varied at will. Two interruptors, with variable disengagement, arranged at the front and back ends, serve to close or open the circuit on the locomotive, which is also provided with reversing gear, acting by change of direction in the current. The outside length of the locomotive is 2·3m. (under 8ft.), width 0·72m. (2ft. 5in.), and height 1·5m. (5ft.). The weight was originally 1·8 metric ton; but, as the adhesion was insufficient on the south rolley-way, the wheels were cast full and supplemented by counterweights, so as to bring the total weight up to 2·3 metric tons (2¼ tons).

There was no loss of current along the line. A series of careful experiments in the south rolley-way, with a gradient of 1 degree, showed the power of the electric haulage, and of the mechanical yield obtained. The results, with all corrections made, are summed up in the following table:—

No. of Experiment.	No of Corves Drawn.	Speed of Train in Metres per Second.	Work in Horse-power.	Useful Effect, including Locomotive.	Useful Mechanical Effect.	Commercial Useful Effect.	Corve Metres.
					Per cent.	Per cent.	
1	0	2·50	10·86	3·06	27	—	—
2	15	2·38	19·33	11·3	58·5	43·28	35·7
3	15	3·46	18·21	14	77	54·48	41·5
4	12	2·50	17·37	10	57·5	40·70	30
5	4	1·49	13·96	3·37	24·07	12·46	6
6	8	3·20	16·14	10·	61·95	38·56	25·6

The moderator limits the number of ampères expended, but does not regulate it; in the first and fifth experiments it was kept closed, and yet the current passed from 16 to 20 ampères. In the second and third, when it was wide open, the expenditure was the same, the difference of work done being due to the voltage. In the fourth and sixth, when it was three-quarters open, the quantity descended from 30 to 25 ampères. The reason of this is that the electric locomotive carries its own regulator, which, for the same position of the moderator, varies the quantity of current given out in accordance with the work to be done.

From this fact may be deducted three practical hints: (1) It is important that the gradient should be uniform, so as never to exceed the number of ampères which the rheostat is capable of supporting; (2) with too light a load the useful effect would be slight, as it is with all engines, on account of the great loss of useful work through friction and resistance; (3) a comparison of the second, third, fourth and sixth experiments shows that it is better to increase the speed rather than the load (although deadweight enters for a large part), electric engines being made for high speeds.

With respect to the third and fourth experiments, for the same number of corves drawn, on opening the moderator full instead of three-quarters, an increase of 40 per cent. in speed was obtained, while the amp.-voltmeter showed an increase of only 5 per cent. The maximum useful effect was obtained in the third experiment, with 12 corves, at a speed of 3·46m.; but, if that speed were adopted constantly, the engine might run off the rails at the points, such a speed being only practical in a straight line and with a considerable length of way. Under existing circumstances it was found best to run with the moderator open, the locomotive drawing a train of 15 corves at a speed of 2·38m. (7ft. 10in.) per second. The useful mechanical effect was 58½ per cent., which might be improved by changing the ratio of the gear, so as to maintain the same speed in the locomotive while giving the armature a higher speed, which would permit of drawing 20 corves in a train.

As regards the cost price, with 15 corves in a gang, at a speed of 2·5m. (over 8ft.) per second, or 9 kilometres (5½ miles) per hour, the locomotive could do a work of 243 ton-kilometres, for which four horses, with one in reserve, would be required. The two locomotives would therefore, if running constantly (a necessary condition of economical working), take the place of ten horses, though in that case it would be advisable to have a third locomotive in reserve. The installation cost:

	Francs.
Steam engine	10,562·50
Steam pipes, fittings, erection, etc.	6,093·45
Dynamo	4,934·50
630m. of insulated conductor	1,317·50
Erection of electric plant	3,306·31
Total for fixed plant	26,714·26
1400m. of electric permanent way at 5·70fr.	7,980
Three locomotives	19,500
General total	54,194·26

The current daily expense is as follows:

	Francs.
Interest on capital of 54,194·26fr. and sinking fund, say ten years, and 300 days in the year, per day	18·06
Fuel, 2kilos. (4·4lb.) per horse-power per hour, say 800kilos. in ten hours	5
Wages—two engine drivers at 3·50fr., two firemen at 2·50fr., two guards at 1·50fr., and 20 per cent. allowance for saving	18
Total	41·06

which takes the place of a daily expense for horses of:

	Francs.
Amortissement of ten horses, 200fr. × 10 ÷ 300 days	6·66
Feed, 2·7 × 10 × 7 days ÷ 6 days	31·50
Wages—8 drivers at 3·50fr. + 20 per cent. allowance	33·60
Total	71·76

Which shows, in favour of the electric locomotives, a daily saving of 30·7fr. (24s. 6d.), or 42½ per cent.

Per ton-kilometre the cost of haulage by locomotive is 0·084fr., and by horses 0·148fr. Drawing trains of twelve corves at a speed of 3·46m. (over 11ft.) per second, or 12½ kilometres (7½ miles) per hour, the locomotive is capable of performing a work in coal hauled of:

$$\frac{450 \times 12 \text{ corves} \times 12{\cdot}5 \text{ kilometres}}{2} \times 8 \text{ hours}$$

$$= 270 \text{ ton-kilometres.}$$

Per ton-kilometre the cost of electric haulage will thus be:—

$$\frac{0{\cdot}084 \times 243}{270} = 0{\cdot}076\text{fr.},$$

or 50 per cent. of the cost of horse transport.

In the above figures the incidental expenses connected with both locomotives and horses have been neglected, as they balance one another; but, during holidays and stoppages, and especially during strikes, horse-keep is a serious item, while, with electric haulage, a horse epidemic would be less disastrous in a colliery.

As regards the advantages afforded by electric haulage for conveying the men to their work, when the coal is being got at a distance of 3 kilometres (1½ miles) from the shaft, a man takes half-an-hour to go to his work, and half-an-hour to return.

At a speed of 9 kilometres (5½ miles) per hour (which it is hoped will be exceeded), the 2 kilometres will be traversed in two-ninths of an hour; for going and returning therefore each man will save $\frac{2}{9} \times 2$, or half-an-hour, and will be fresher for his work. This saving of time multiplied by 800 men represents 400 hours or 50 days, which at the rate of 4fr. (3s. 3d.) constitutes a daily saving of 200fr. (£8), to which must be added an increased production of:

$$\frac{\frac{1}{2} \text{ hour}}{8 \text{ hours}} = \frac{1}{16}, \text{ or 6 per cent.}$$

The conclusion the author comes to is that, in non-fiery mines, haulage by electric locomotives is commercially practical and advantageous; but great care must be bestowed on all the details of the installation.

The Belfast Mechanical and Engineering Association.

THE above association on Saturday, the 5th inst., paid a visit to the Cogry Mills, Doagh. There was a very full attendance of members, including the honorary president (Mr. John Erskine, J.P.), Messrs. Graham Lindsay, T.C., Prospect Mills; James Johnston, Donegall-street; Edward Winnington, etc. The party left the Northern Counties Railway Station by the three o'clock train, and on their arrival cars were in waiting to convey them to the mills, about three miles distant. The principal object of the visit was to see the new four-cylinder triple-expansion steam engines, lately erected by Messrs. Daniel Adamson and Co., Manchester, the principal dimensions of which are as follow:—H.P. cylinder, 14in. diameter; intermediate, 24in. diameter; two L.P. cylinders, each 26in. diameter; all are 4ft. stroke, and when running at 70 revolutions per minute will develop 600I.H.P. The fly-wheel is 18ft. diameter, and suitable for 20 ropes. The cylinders are fitted with the Wheelock expansion gear, and arranged horizontally, two on each side of the fly-wheel. The details of these engines have been well thought out. The steam is supplied by two Lancashire boilers, 30ft. long × 7ft. 6in. diameter, constructed by Messrs. Joseph Adamson and Co., to suit a working pressure of 160lb. Messrs. J. Hopkinson and Co., of Huddersfield, supplied their excellent fittings for these boilers.

Since Mr. McMeekin took over these works they have been considerably enlarged by having additional buildings and machinery erected. In these changes he displayed shrewd perception in respect to economy. Cogry being a considerable distance from the railway, the expense of cartage in the coal supply was a difficulty with him. The engines are capable of developing double the horse-power they are now doing, which is a provision for further extension in the concern. As the engines are working at present, only half the coal is required to drive the same machinery as compared with the old system.

After the inspection of the engines, boilers, electric installation, etc., the party adjourned to partake of a substantial luncheon.

Shipbuilding Notes.

Messrs. A. Roger and Co., shipbuilders, Port-Glasgow, launched, on the 9th inst., a steel sailing ship of 1700 tons, to carry about 2800 tons deadweight, for Messrs. Thomas Williams and Co., Liverpool. The dimensions are:—Length, 260ft.; breadth, 38ft; depth, 23ft.

Messrs. Sir Raylton Dixon and Co., of Middlesbrough, have launched a steel screw steamer of about 7000 tons deadweight capacity, for Messrs. Thomas and James Harrison, of Liverpool. Her dimensions are:—Length, 415ft.; breadth, 45ft.; depth (moulded), 31ft. 3in. The engines were constructed by Messrs. Thomas Richardson and Sons, with cylinders 25in., 41in., and 68in. diameter, by 54in. stroke.

On the 8th inst. the steamer "Pole Star," built and engined by the Fairfield Engineering Company, Glasgow, went on her trial trip. She is 175ft. by 26½ft. by 14½ft. Two sets of triple-expansion engines, each with cylinders 14½in., 24in., and 39in. diameter, easily maintained on trial the contract speed of 13 knots, the steam being supplied from two single-ended steam boilers, fitted with corrugated furnaces, and working at a pressure of 160lb.

Messrs. Short Brothers launched from their yard at Pallion, on the 3rd inst., a steel screw steamer built to the order of the Sunderland Steamship Company, Sunderland, of the following dimensions:—Length, 300ft.; breadth, 40ft. 4in.; and 26ft. 6in. depth moulded. Messrs. W. Allan and Co., of Sunderland, will supply triple-expansion engines having cylinders 22½in., 37in., and 61in. diameter, by 42in. stroke.

On the 5th inst. Messrs. Wm. Gray and Co. Limited launched the steel screw steamer "Conch," the second of the steamers they are building for Messrs. Samuel and Co., of London, for the bulk petroleum trade to the East through the Suez Canal. Her dimensions are:—Length over all, 349ft.; breadth extreme, 43ft.; depth, 28ft. The vessel will be fitted with a very powerful set of triple-expansion engines of the well-known type, manufactured at the Central Marine Engine Works of Messrs. Wm. Gray and Co. Limited. The cylinders will be 25½in., 40½in., and 67in. diameter respectively, and 45in. stroke. There are three large single-ended boilers to supply steam at a pressure of 160lb. per square inch.

The Laws of Friction.*

THIS seems to be an age of errors in relation to friction, as many scholarly mechanics appear to no longer comprehend the true meaning of the natural laws controlling friction, although seemingly very simple when understood. The fault is no doubt in a large measure due to the old masters, whose text-books are still relied upon by the masses. It is not that the old teachers were wrong in the enunciation of general principles, but were faulty in detail. They rested their law on the success of general results, obtained during the experimental era, leaving coming generations to work out the details for themselves; but that very many fail to do and accept general results as covering the whole ground, something the masters of old would not have dared to do themselves. As an example, we will take the general statement that friction is independent of surface, time, or velocity. The statement is true when properly interpreted, and just as untrue when an improper construction is put upon it. Properly interpreted it means that, other things being equal, friction is neither increased nor decreased by increase or decrease of surface. Other things being equal, time has no influence, either way, on the coefficient of friction, it remaining constantly the same. Other things being equal, velocity, which is another way of expressing time, has no influence either way upon the coefficients of friction. To illustrate the first idea, we may take a square block of wood, iron, or any other kind of material that may be desired, put a perfectly smooth face on it that will closely fit another smooth surface, and slide it back and forth a given number of times in a given period of time, and the frictional resistance is established. If the sliding block or its sliding surface is doubled in size and exactly the same motion is given it, there will be no increase in frictional resistance, provided, of course, there has been no increase in the weight of the moving block. If we increase the sliding surface four times in size without increasing the weight, the frictional resistance in the aggregate will still be the same with the same motion. Viewed from that standpoint alone there is, nor can be, no increase of frictional resistance by increase of surface so long as the conditions of the surfaces remain the same. But if, instead of moving the sliding surface at the given rate, the velocity be doubled, we add a new factor which, while it does not change or increase the coefficient or original unit of resistance, multiplies it by two, which gives an aggregate of resistance twice as great; and right there is the stumbling block over which many fall. They take the general statement as it stands, and arrive at the conclusion that, no matter how much surface or velocity may be increased, friction, or frictional resistance, in the aggregate remains the same, while it is the coefficient only that remains unchanged. Coefficients may be multiplied infinitely; and so it was understood by the old masters, and by them it was probably never dreamed that any other construction would be put upon this general declaration. The false construction placed upon the laws of friction is unfortunate, in that it effectually misleads young learners who are striving to become masters of mechanics and mechanical law of all kinds.

While smooth, flat surfaces very clearly indicate the workings of friction laws in a general way, and answer well for experimental purposes, it is still important to carry the knowledge thus obtained beyond the experimental stage into the more active fields of practical mechanics, in order to make the information of real value to the every-day mechanic. What the embryo mechanical engineer requires is to know how the laws of friction affect running machinery. The effect is about the same in a general sense, but varies some in detail; the most notable difference being in the operation of circular, convex, and concave surfaces when in sliding contact with each other—as, for instance, when brakes are applied to wheels, belts to pulleys, and the like. For reasons so far unknown to the scientific and mechanical world, or at least so far unexplained, we here discover a condition that actually nullifies said laws. We find that by increasing the length of a common brake block on a wagon wheel, we at the same time increase its holding power; for, whereas the wheel might have stopped with a short block, a longer one holds it very firmly, and that, too, without adding any additional weight. The same is true in reference to belts, which are perhaps better understood by the average mechanic than are wheelbrakes. If a belt slips and refuses to do its work, its stubbornness can

*By R. James Abernathey in "The Mechanical News."

be speedily and effectually cured by increasing its lap around the pulley. In both of these cases frictional resistance is increased by simply increasing the contact surfaces without adding anything to the weight or tension. This is rather a startling violation of natural law that was probably entirely overlooked by those who, many years ago, discovered and divulged the laws of friction. But, as said, while we now know the fact we are unable to explain the cause.

Turning aside from the discordant feature of the business, we shall strike a more harmonious chord in looking upon the operations of a common shaft. The practice is to hang a shaft in a number (two or more) of journal boxes a few inches in length, that being done for convenience and to leave the main portion of the shaft freed for the reception of pulleys, etc. So far, however, as friction is concerned, it would not matter whether the shaft were suspended in two or more bearings or encased its entire length in a journal box, provided the shaft was perfectly finished from end to end and the bearing surface perfect also. Here, again, do we have the theory of friction being independent of surface truthfully illustrated. A shaft 12ft. in length will run just as freely in a journal box 12ft. long as it will in three short ones of 6in. or 8in. in length, all the work being perfect. But now we take two shafts of a given length, one a solid 2in. shaft and the other a hollow 4in. shaft, both having exactly the same weight, and we find, by revolving both an equal number of revolutions, that the frictional resistance of the 4in. shaft is just twice that of the 2in., while yet the weight of both is the same. Here, again, we have unimpeachable evidence that friction is not independent of surface and velocity when measured in the aggregate, although the units or coefficients remain the same. It thus becomes quite plain that, to understand the operations of the laws of friction, we must be able to distinguish the difference between units or coefficients and aggregate resistance when units are multiplied.

The Value of the Steam Jacket.

(*Continued from page* 188.)

COMPOUND NON-CONDENSING ENGINE.

No. 38.—Record of two experiments on same engine, with and without steam in the jackets.

Compound Non-condensing Armington Engine.—Cylinders 9·45in. and 14·17in. diameter, 10·04in. stroke. Experiments made at Mulhouse, Alsace, in 1889, by M. Walther Meunier (Société Industrielle de Mulhouse, 1890, vol. lx.). Steam was supplied by a locomotive boiler which was overworked. A brake was used to absorb the power. This is the same engine as for the set of experiments No. 39, but here used without the condenser.

Jackets, with or without steam	Without.	With.
Boiler pressure, lb. per sq. in. above atmosphere..lb.	117·3	117·3
Revolutions per minute ..	298	293
Piston speeds, feet per minute .....feet	499	499
Results.—I.H.P.	83·6	84·4
Jacket water, lb. per I.H.P. per hour ....lb.	—	1·18
Jacket water in percentage of feed water ..p.c.	—	4·7
Feed water, lb. per I.H.P. per hour, total .....lb.	26·29	25·25
Feed water percentage less with steam in jackets	—	4·0 p.c.

COMPOUND CONDENSING ENGINES.

No. 39.—Record of two experiments on same engine with and without steam in the jackets.

Compound Condensing Armington Engine.—Cylinders 9·45in. and 14·17in. diameter,

Jackets, with or without steam	Without.	With.
Boiler pressure, lb. per sq. in. above atmosphere..lb.	112	111
Revolutions per minute ..	302	302
Piston speed, feet per minute .....feet.	505	505
Results.—I.H.P.	82·9	83·0
Jacket water, lb. per I.H.P. per hour ....lb.	—	0·85
Jacket water in percentage of feed water ..p.c.	—	3·9
Feed water, lb. per I.H.P. per hour, total .....lb.	22·85	21·57
Feed water, percentage less with steam in jackets	—	5·6 p.c.

(See also set of experiments No. 38.)

10·04in. stroke. Experiments made at Mulhouse, Alsace, in 1890, by M. Walther Meunier (Société Industrielle de Mulhouse, 1890, vol. lx.). The engine was worked with a Körting condenser and without an air pump.

No. 40.—Record of two experiments on same engine with and without steam in the jackets.

Pair of Compound Jet-condensing Beam Pumping Engines, with four slide valves to each cylinder.—Cylinders 19in. and 31in. diameter, 44·6in. and 66in. stroke; all four bodies and both ends of the two low-pressure cylinders were jacketed. Experiments made at Copenhagen Waterworks in February, 1890, by Mr. F. Ollgaard (Tekniske Forenings Tidsskrift, Copenhagen, 1890). The whole steam supply to the cylinders passed through the jackets when in use.

Two other jacketed experiments also are recorded, in which the pressures in the two low-pressure jackets were reduced to about 14·25lb. per sq. in., giving a mean consumption of 20·56lb. of feed water per I.H.P. per hour, or a reduced economy of 15·0 per cent. due to this arrangement of jacketing.

Jackets with or without steam	Without.	With.
Duration of experiment hours	8	8
Boiler pressure, lb. per sq. in. above atmosphere..lb.	52·5	51·25
Number of expansions	13·82	14·61
Revolutions per minute ..	19·1	24·0
Piston speeds, feet per minute .....feet	142 & 210	178 & 264
Results.—I.H.P.	65·8	81·2
Jacket water, lb. per I.H.P. per hour ....lb.	—	—
Jacket water in percentage of feed water ..p.c.	—	6·0
Feed water, lb. per I.H.P. per hour, total .....lb.	24·18	19·69
Feed water, percentage less with steam in jackets	—	18·6 p.c.

TRIPLE-EXPANSION CONDENSING ENGINE.

No. 41.—Record of two experiments on same engine with and without steam in the jackets.

Triple-expansion Condensing Vertical Inverted Engine, on three uncoupled cranks, with cylinders provided with Meyer expansion gear.—Cylinders 5in., 8in., and 12in. diameter, 10in., 10in., and 15in. stroke. All the bodies, ends, and valve-chests of the three cylinders were jacketed, as also were both receivers, and part of the steam pipe, steam being admitted to the last three jackets throughout both of the experiments. Experiments made at Owens College, Manchester, in January and April, 1889, by Professor Osborne Reynolds (Institution of Civil Engineers, vol. xcix., 1889). Steam was supplied to each of the fifteen jackets by a separate pipe, and all the jacket water was drained through the first receiver into the boiler. In the high-pressure cylinder 64·7 per cent. of the internal surface is jacketed, in the intermediate cylinder 67·1 per cent., and in the low-pressure cylinder 75·2 per cent. Three independent brakes were used to absorb the power.

Jackets, with or without steam	Without.	With.
Duration of experiment..... hours	4·0	4·1
Boiler pressure, lb. per sq. in. above atm. .....lb.	188	192
Number of expansions	15	26·5
Revolutions per minute .....revs.	322 & 320 & 276	230·5, 298 & 299
Piston speeds, feet per minute....feet	5·7 & 533 & 690	383 & 497 & 717
Results.—		
Indicated horse-power ....I.H.P.	73·9	72·1
Coal, lb. per I.H.P. per hour.....lb.	1·62	1·33
Coal, percentage less with steam in jackets .. p.c.	—	17·9
Jacket water, lb. per I.H.P. per hour.....lb.	[2·14]*	3·29
Jacket water, in percentage of feed water ..p.c.	[13·0]*	24·3
Feed water, lb. per I.H.P. per hour, total ..lb.	16·12	13·56
Feed water, percentage less with steam in jackets	—	17·4 p.c.

*Jacket water from receiver and steam-pipe jackets only.

RECORDS OF FIVE SETS OF EXPERIMENTS ON THE VALUE OF THE STEAM JACKET.

No. 42.—Experiment on a compound beam engine at the West Middlesex Waterworks, Hammersmith, by Mr. John G. Mair-Rumley.

Engine.—The engine on which the experiment was made, diagram 1, is a compound jet condensing beam pumping engine made by Messrs. James Simpson and Co., of Pimlico. The diameters of the cylinders are 29in. and 47·5in. Their strokes are 65·1in. and 96in. respectively. The diameters of the piston rods are 4⅞in. and 5¼in. respectively.

Only the body of each cylinder is jacketed, and steam is supplied to both jackets direct from the boiler at a pressure of 49lb. per square inch above the atmosphere.

The following shows the amounts of the jacketed and unjacketed portions of the inner surfaces of the cylinders:—

Cylinder.	Area of Inner Surface.		
	Jacketed.	Unjacketed.	Total.
H.P.—	sq. ft.	sq. ft.	sq. ft.
Body	41·18	—	50·35
Ends	—	9·17	
Per cent.	81·8 p.c.	18·2 p.c.	100·0 p.c.
L.P.—			
Body	99·48	—	124·01
Ends	—	24·53	
Per cent.	80·2 p.c.	19·8 p.c.	100·0 p.c.

Details of Experiment.—The experiment consisted of two trials which were made at the West Middlesex Waterworks, Hammersmith, on 21st, 22nd, and 23rd March, 1888, by Mr. John G. Mair-Rumley. The first trial, during which steam was admitted into both jackets, commenced at 9-0 p.m. on 21st March, and was continued without stoppage until 5-0 a.m. on the 22nd. The second trial, during which no steam was admitted into either jacket, commenced at 6-15 p.m. on 22nd March, and was continued without stoppage until 4-15 a.m. on the 23rd. There were thus two separate trials, the first with steam in both jackets and lasting 8 hours, and the second without steam in either jacket and lasting 10 hours. All the other conditions were maintained as far as possible the same throughout both of the trials.

Feed-water Measurement.—The feed-water was measured in two tanks; the smaller of the two was placed above the other, and was used as a measuring tank. Its capacity up to the overflow pipe was 395lb. of water at the feed temperature; and when this was allowed to run into the lower tank, to which the feed pump of the engine was connected, the water level in the lower tank was raised 8¼in. as measured from a mark near its upper edge. The number of times the upper tank was filled and emptied into the lower tank was checked by means of a counter, which was read at the beginning and end of each trial.

Feed-water Consumption, with Steam in Jackets.—At the commencement of the first trial, when steam was admitted into both jackets, the water level in the lower tank was 14⅔in. below the datum mark. After the trial was started, a large amount of water was found in the indicator pipes (which were well lagged) and seemed to point to priming; it was therefore thought advisable to lower the water level in the boilers, in order to obtain drier steam. No water was pumped into the boilers from 10-50 p.m. to 11-50 p.m. From the commencement of the trial at 9-0 p.m. until 10-50 p.m., or during 1 hour 50 minutes, the water level in the boilers was kept constant, and 13½ tanks of water were fed into the boilers, being at the rate of 48·5lb. per minute. From 10-50 p.m. till 11-50 p.m. the feed was stopped, and the water level in the boilers gradually fell. From 11-50 p.m. till 4-0 a.m., or during 4 hours 10 minutes, the water in the boilers was kept constant at this lower level, and 31 tanks of water were fed into the boilers, being at the rate of 49·0lb. per minute. From 4-0 a.m. to 5-0 a.m. the feed was increased; so that at 5-0 a.m., when the trial was stopped, the water in the boilers had reached the same level as it had at the commencement. During the last hour 12½ tanks of water were fed into the boilers, being at the rate of 82·3lb. per minute. At the end of the trial the water level in the lower tank stood 3¼in. higher than it did at the beginning, and this has been allowed for in the totals. The total feed water used when steam was admitted into both jackets was thus 22,360lb. in 8 hours, equivalent to 2795lb. per hour, or 46 58lb. per minute.

Feed-water Consumption, without Steam in Jackets.—In this trial steam was entirely shut off from both jackets, and the jacket drain pipes were open to the air. The feed was continuous throughout the whole of the trial. The water level in the boilers remained very nearly constant, and was precisely the same at the beginning and end of the trial. During the trial 75 tanks of water were emptied into the lower tank, and at the end the water level in the lower tank stood 2⅞in. higher than it did at the commencement, and this has been allowed for in the totals. The total feed water used when no steam was admitted into either jacket was therefore 29,487lb. in 10 hours, which is at the rate of 2949lb. per hour, or 49·15lb. per minute.

Jacket Water.—The drain pipe from each jacket was made to deliver into a separate bucket. Each of these buckets held 31½lb. of water at the temperature at which it left the jacket; but as a certain amount was unavoidably lost owing to splashing over the edge, 33lb. has been taken as the actual quantity of jacket water represented by each bucketful. During the trial with steam in both jackets, 22 buckets or 726lb. of water were drained from the high-pressure jacket, and 27 buckets or 891lb. from the low-pressure jacket. These correspond to 90·75lb. per hour or 1·51lb. per minute from the high-pressure jacket, and 111·37lb. per hour or 1·86lb. per minute from the low-pressure, and to a total of 202·12lb. per hour or 3·37lb. per minute from both jackets.

(*To be continued.*)

Trade Notes.

The Whitney Safety Firearms Works, of Massachusetts, intend erecting works at Allentown, Pa., capable of turning out 30,000 rifles per year.

Messrs. Ashmore, Benson, Pease and Co., of Stockton, have just completed a telescopic lift for a gas-holder, for the Carlisle Corporation.

The Glengarnock Iron and Steel Company are having plant fitted up at their works for the utilisation of what have hitherto been considered as waste products.

Messrs. Blake, Barclay and Co., engineers, Victoria Works, Greenock, have received a contract to supply the machinery for a large sugar refinery in Australia.

It is stated that the Union Tube-making Company, Lanarkshire, have obtained an order for 35,000ft. of 2½in. tubes for the London Electric Lighting Company.

A Vogt compound locomotive now being built at the Altoona shops of the Pennsylvania Railroad Company, is approaching completion. It will have 7½ft. driving wheels.

The Ladyburn Foundry, Greenock, which has been closed for several years, has recently been relet, and it is expected that active operations will be recommenced shortly.

The Reading Rolling Mill Company, of Reading, Pennsylvania, have received an order for 1500 tons of structural iron for a seventeen-storey office-building to be erected in Chicago.

Messrs. Lobnitz and Co., Renfrew, have received an order for twelve small lighters for the Manchester Canal service. They are to be partially fitted up, and then transferred to the Canal.

Messrs. Isaac Storey and Sons, of Knott Mill, Manchester, are erecting a branch works at Cornbrook, where they intend to carry on their iron-founding and copper-smithing departments.

The Woodside Iron and Steel Works, Coatbridge, which have been closed for a considerable time, have begun operations again under the new proprietors, Messrs. Mitchell and Bennett.

Messrs. Sir W. Armstrong and Co., of Elswick Works, Newcastle-on-Tyne, have received the contract for the hydraulic machinery for the railway bridge over the river at Neath, South Wales.

Messrs. James Eadie and Sons, Clydesdale Tube Works, Glasgow, have received the order for the boiler tubes for the locomotives placed with the Atlas Locomotive Works, Springburn. They are to be of steel, with galvanised copper ends.

The Cast-steel Foundry, Middlesbrough, was again offered for sale by public auction on the 8th inst. The only bid, however, was one of £1000 by Mr. Wm. Richards. The property, which originally cost nearly £40,000, was withdrawn.

It is reported from Queensland that the new duty of £2 per ton on cast-iron pipes affects the shipments of those now being received from Glasgow by the Brisbane Board of Waterworks, under contract with Smellie and Co. The contract was let in May last, the duty then being 15 per cent.

The Unbreakable Pulley and Mill Gearing Company Limited, of West Gorton, Manchester, in order to further facilitate their increasing business in London and the South of England, have opened offices and showrooms at 56, Cannon-street, London, E.C., where they have a very large and varied stock of their standard articles.

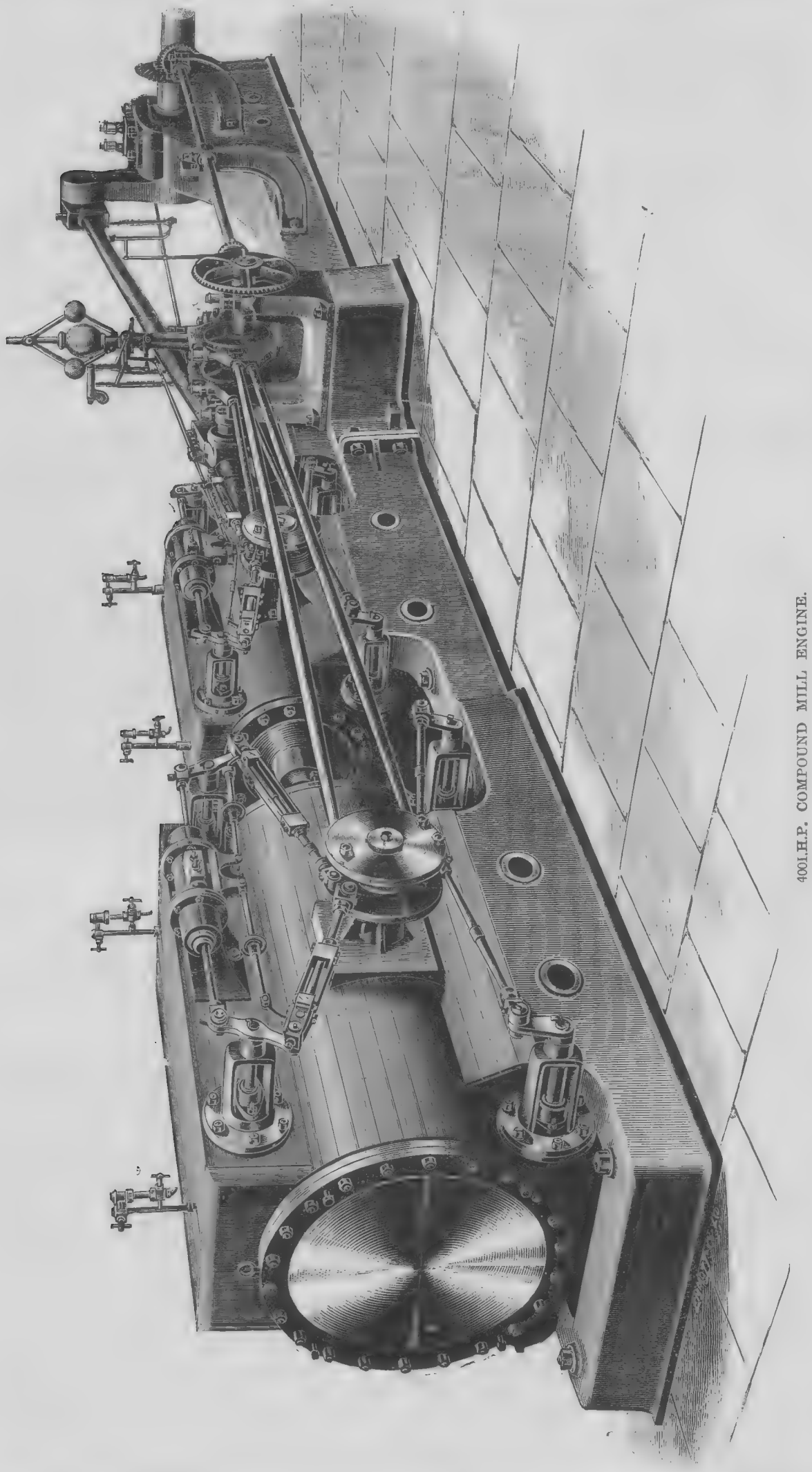
Readers of "The Mechanical World" are invited to send to the publisher of "Good Health," the new weekly paper devoted to food, drink, medicine, and sanitation, for a parcel of specimen copies, which will be sent gratis and post free, for distribution among their friends at home and abroad. Address, 391, Strand, London, or New Bridge-street, Manchester.

Wheel cutter in metal only. Every description of gearing. R. Chidlaw, 43, City-road, Manchester.

Having regard to the enormous circulation of The Mechanical World, the Editor suggests that it is by far the best medium for the insertion of every kind of "Wanted" advertisement, and the price is only one halfpenny per word. The Editor will be glad if Mechanical World readers will kindly bear this in mind as occasion arises.

400I.H.P. Compound Mill Engine.

We have pleasure in illustrating herewith a very neatly-designed and substantially-built compound mill engine of 400I.H.P., constructed by Messrs. Cole, Marchent and Morley, Prospect Foundry, Bradford, for a spinning mill at Laisterdyke. The engine, which is of the tandem-compound type, has cylinders 18in. and 33in. in diameter, and a stroke of 5ft. Both cylinders are steam-jacketed, and fitted with Corliss valves and trip gear. The cut-off in the high-pressure cylinder is controlled directly by the governor, while that in the low-pressure cylinder can be regulated by hand whilst the engine is in motion. The connecting rod is 15ft. long, and the brasses are provided with square corners to prevent rotation. Where possible, all the rod ends are made solid, the brasses being let in with flanges, and provided with screws and wedges for adjustment. The air pump is placed under the floor level in the usual way, and is 28in. in diameter, and has a stroke of 15in. The crankshaft journal is 11in. in diameter and 22in. long, and the fly-wheel, through which about half the power is transmitted, is 20ft. in diameter, and is grooved for nine 1¼in. ropes. The weight complete is 20 tons. The crankshaft also carries another driving-pulley, which, in order to allow the ropes to clear a doorway, is smaller in diameter than the fly-wheel. This second driving-wheel has also nine grooves for 1¼in. ropes, and as the pull of the two sets of ropes is in opposite directions and approximately equal in amount, they counteract each other to a very considerable extent.



400I.H.P. COMPOUND MILL ENGINE.

The engine has now been running for about four months; but it has only been possible to make one week's test, when, taking the total running of the engine, exclusive of steam required for combing and shed work, the coal consumption was found to be 2·2lb. per I.H.P. per hour. The average cost of the coal in this case is about 6s. 3d. per ton.

From the diagrams it will be seen that the distribution of steam is found to leave nothing to be desired. At present the maximum boiler pressure is 85lb. per square inch, but the engine has been designed throughout for 100lb. pressure. During the time it has been running the engine has proved exceedingly satisfactory in every way. We may add that we have recently had the pleasure of inspecting the engine while running under full load. It has an exceedingly neat appearance, and is in every respect well designed, while the workmanship which the makers have bestowed upon it is of the highest class.

Corrugated Furnaces.*

The three principal advantages claimed for corrugated furnaces are (*a*) increased heating surface, (*b*) increased strength, and (*c*) greater expansibility. These we will consider in the order given. It is evident that if we measure along the wavy line which is shown in longitudinal section of corrugated furnaces, a much larger surface is exposed to the flame than if there were no corrugations. For simplicity we will say that this gives an increase of 50 per cent.—a liberal estimate in favour of the corrugations. Therefore, the amount of plate exposed would be equal to that of a plain tube of the same diameter as the corrugated one, but one-half as long again. Or if two plain tubes were of the same length, and one of them 2·9ft. diameter and the other 3·4½ft. diameter, we would have the same increase of heating surface as between two tubes of equal diameter and length, but one plain and the other corrugated; while in the corrugated tube there would be practically no diminution of strength such as there would be in the plain tube of larger diameter. Considerations such as these lend themselves readily for purposes of advertisement, but as every seller presupposes a buyer we will see how the latter regards the matter.

First of all, and to a certain extent, the increase of surface is more apparent than real, for though there is more surface of plate there is not necessarily more effective heating surface, for the corrugations introduce certain disadvantages which modify the calculation. For one thing, any loose or muddy deposit within the boiler tends to settle at the lower part of the corrugations, and it finds its chief resting place on the upper part of the tube where the hottest flame plays. It is true that along a plain tube it tends to settle on the same upper part, and in either form of tube the total amount of deposit may be the same, or, owing to the upper part of corrugations being left comparatively clear, there may be a smaller total amount of deposit in the corrugated than on the plain tube. Where locally deposited in the place stated it tends, however, to be thicker than on the plain tube; while as its resistance to the transmission of heat increases in a faster proportion than its direct thickness, the advantage got from its possible less total amount is thus largely discounted.

There is, however, another loss due to deposit, and this is on the fire side of the furnace plates and is due to soot. As the heated gases impinge on the lower part of the corrugations, these act as a series of baffle plates and deflect the flame, which in any case could not easily execute the zig-zag movement which would be necessary to enable it to play upon the back and upper parts as well as the front side of the corrugations. At the back of each projection there must necessarily be a kind of eddy or backlash of the flame. This is the precise condition required for the deposit of soot, and in many, if not all, of these furnaces, whenever the draught is of less intensity than usual, soot lodges in the upper recesses of the corrugations. The same result follows when an insufficient supply of air gets to the fire. This soot may not be of any great thickness, but a layer of less than $\frac{1}{32}$ of an inch materially retards the transmission of heat, and as this layer on the fire side is precisely at the places where the tube is most free from deposit, on the water side, the advantage due to such absence of deposit is largely nullified. We, therefore, must conclude that owing to deposit on both the water and fire side of furnace plates the transmission of heat is obstructed all along its length, and the advantage gained by increased surface is, under ordinary conditions of service, largely lost. But there is another point in reference to heating surface that must not be

* "American Shipbuilder."

overlooked. It is in reference to radiation as opposed to conduction.

In a plain tube the gases are in intimate contact with the furnace plate, and the heat that passes from them is directly conducted through the iron. As the flame rolls over and over fresh heat is being constantly applied to the plate, and radiation hardly comes into play. It is not so with a corrugated furnace. Even if the plates at the upper part of the corrugations could be kept as bright and clean as in an ordinary furnace (which they cannot), yet it is impossible for the flame at its edges to travel onward at a speed much slower than the main body of the flame, so that its fringes may be able to go in and out of the corrugated recesses with the regularity of clockwork, while keeping in intimate contact with the plates all the time. On the contrary, the flame as it rushes along must radiate its heat into its recesses, and such radiation must pass through the cooler gases that eddy and linger there. This invisible obstruction to the radiated heat, though perhaps not of great amount, must be taken into consideration in the question of effective heating surface due to corrugations.

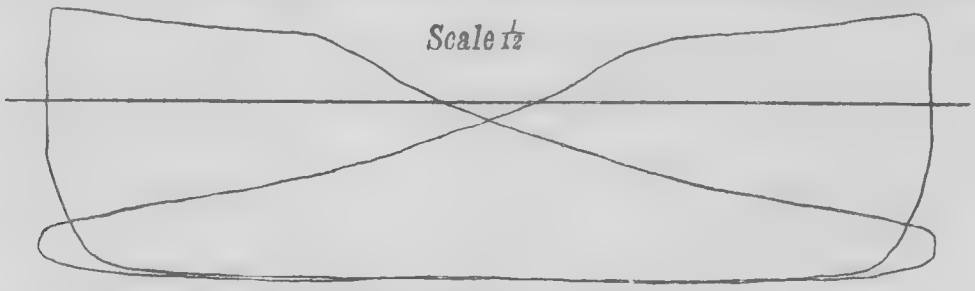
There is, however, an important factor yet to be noted, and one which is ignored when the surface of plate exposed is regarded as identical with heating surface, while if the majority of the other practical defects did not exist this one would remain. As the flame passes along from one corrugation to another, and radiates its heat into the recesses, it is unfair to count all the surface of the corrugation as heating surface, as may be seen thus:—Suppose a red-hot block be placed close to a certain area of a plain furnace plate without touching it, then the whole of the upper surface of the block would be radiating its heat to the part of the plate immediately above it. Instead of a plain plate let the block now be transferred to a corrugated recess and be just wide enough to reach from one corrugation to the next. The total amount of heat radiated would be the same in either case, for the greater surface exposed by the arch of the corrugation the corrugations, though this again is partly discounted by the other matters noted above. The balance seems, however, to incline in favour of the corrugated furnaces as far as heating surface is concerned.

(To be continued.)

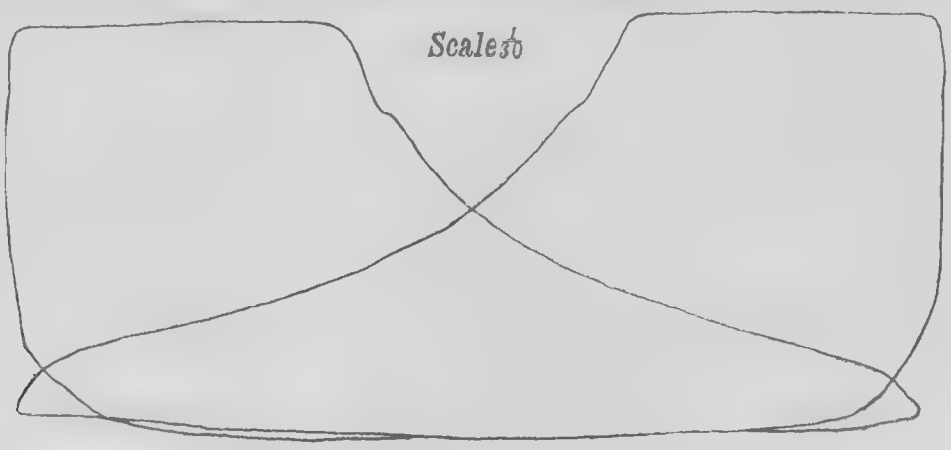
Mason's Lever Stone Breaker.

THE accompanying illustration represents a new form of lever stone breaker, or cracker, now being introduced by Messrs. S. Mason and Co., of Leicester, for the continuous breaking of very hard granite and other hard stones. As will be seen, the machine is simple and substantial in construction, and will doubtless prove of especial value for granite quarries. The driving shaft carries an eccentric, which actuates the heavy bell-crank lever shown on the left. Motion is transmitted from the shorter arm of this lever to the swinging jaw stock through an adjustable "toggle plate," as shown. Two grooves are provided in the bell crank, so that by changing the toggle plate from one to the other, the machine may be used equally well for very hard as for ordinary stone. In the former case, the toggle plate is placed in the lower groove, thus imparting a movement of shorter range to the swing jaw. Provision is also made by which the length of this toggle plate can be varied to suit the different stones operated upon. It is claimed for this machine that there are no links or arms to get out of order, and that there is only about one half the usual number of wearing parts, while these can be renewed at but very little cost.

MASON'S LEVER STONE BREAKER.



HIGH-PRESSURE DIAGRAM: COMPOUND MILL ENGINE.



LOW-PRESSURE DIAGRAM: COMPOUND MILL ENGINE.

State of the Skilled Labour Market.

THE following memorandum has been prepared for the "Board of Trade Journal" by the Labour Correspondent to the Board of Trade.

During the month of October the general relations of employers and employed were somewhat less disturbed than in the month preceding. The great stoppage in the cotton-spinning trade was, of course, impending, but did not actually commence until the end of the first week of the present month, and is, therefore, not included in the present notes. Forty-two strikes only were noted during the month, but none of these were of great importance, and some were only of a few days' duration. This is 12 less than commenced during September. Twelve of the strikes took place in the textile trades, 7 in shipbuilding, 6 in the building trades, and 6 in mining and quarrying. The remainder were among miscellaneous trades. In point of numbers involved those in the mining and quarrying group were the most important.

The reports of the unions of skilled trades for the month indicate no signs of improvement in their respective labour markets. On the contrary, they show again a considerable increase in the number of their unemployed. In all 22 trade unions have sent in reports. The aggregate membership of these societies is 268,658. Of these 19,684 are shown to be out of work, as against 16,794 in the previous month; this is a rather considerable increase, and raises the proportion of unemployed from the 6·25 per cent. of the preceding month to 7·33 at the end of October.

In order that the present returns may be compared with those of the corresponding month in previous years, it may be desirable to quote the following figures showing the percentage of unemployed reported in each November back to 1886:—

1886 .. .. 10·1	1889 .. .. 1·8	1891 .. .. 4·45
1887 .. .. 8·6	1890 .. .. 2·6	1892 .. .. 7·33
1888 .. .. 4·4		

This statement indicates very clearly the flow and ebb of the industrial tide; but, taking 1886 as low-water mark, it does not yet appear that the depression at present existing has reached its lowest point.

The building and cabinet-making trades are the only industries that may be considered as at all prosperous; but the former branch of industry is gradually becoming worse.

The shipbuilding, pattern-making, and ironfounding trades are very depressed, and though the engineering branches are in a somewhat more healthy condition, they are bound to be affected by the state of the above cognate trades, which precede them in order of production, and thus feel the full force of depression somewhat earlier. But two are considered "good," seven "moderate," and 13 "bad."

radiant light take radiant heat, and the same law holds good; and this is the case whether we use radiant heat from a red-hot block or from flaming gases. Thus, as far as heat got from radiation is concerned, a corrugated furnace has no more heating surface than a plain one. As, however, the gases, to a slight certain extent, do play in and out of the corrugated recesses, there is a balance of heating surface in favour of

Hints to Young Draughtsmen.

CONTRIBUTED.]

Choosing Instruments. — In selecting drawing instruments, only the best should be chosen. A half-set of compasses will be required, and these should be of electrum, double-jointed needle points, the price of which will be from £1 10s. to £2. A set of three spring bows is also necessary, with needle points, price 13s. 6d. the set. A good drawing pen should be chosen, as it will be in use more often than any of the other instruments.

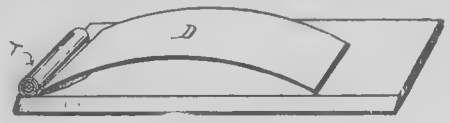


FIG. 1.

Scales for measuring may be fully divided, oval section, 12in. long, for ⅜in., ¾in., 1½in., 3in. = 1ft., on one scale, price 2s. 9d., boxwood. Also a full-size scale, flat section, fully divided to sixteenths on one edge and millimetres on the other, same price. Mahogany-framed, ebony-edged set squares are the best, but very expensive. Vulcanite will answer every purpose at less than half the price. The draughtsman is not usually expected to provide a T-square.

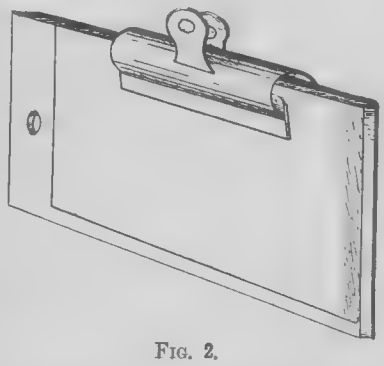


FIG. 2.

The above tools will be sufficient to begin with, but pen and pencil bows should be added at the earliest opportunity—electrum, new pattern, price 12s. 6d. each. Later on hair dividers should be obtained, then beam compasses, proportional compasses, etc.

The following methods of testing instruments will apply to compasses and bows:—Bend the knee joints at right angles, and note if the points come exactly opposite.

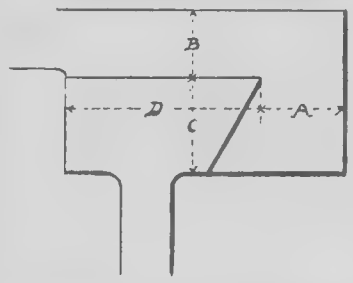


FIG. 3.

Open the compasses to their fullest extent, and ascertain that they move with the same freedom the whole way. Test the needle with the finger nail to see if it shakes at all in the socket. It should fit the hole well at the point. Try a lead in the pencil part, and make sure it is gripped tight when screwed up. If the lead breaks in the process choose another instrument. Work the knee joint back and forward, and note carefully if the little screw turns with

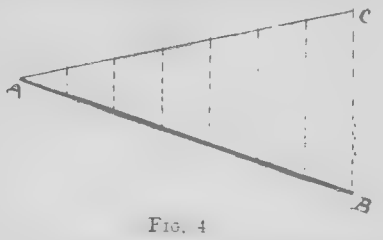


FIG. 4

it. The compass should be rejected if it has this fault, for, although with care it can be set right by filing the screw, it is better to avoid the trouble by judicious selection.

Preparing for Work.—Very likely the drawing paper will be in a roll. It is quite remarkable how awkward some people are at cutting off their paper, usually leaving a jagged slanting edge, and perhaps finding that after all they have cut the paper too small. Put the roll at the top of the drawing board, and let it roll down to the bottom, while the centre of the free end is

held with one hand at the top of the board. The two free corners will then curl over towards the middle and prevent the paper rolling itself up again. Put a 2ft. rule up the centre, and make a mark 2in. longer than the standard size for drawing. Now see that the edge of the paper is parallel with the edge of the drawing board, and rule a line across with the T-square. Cut the paper along this line with a pocket knife.

The next thing is to flatten the paper. It will be necessary to roll it the reverse way to a smaller diameter than at first. To do this, take a roll of tracing cloth T (Fig. 1), and place the paper as at D. Now roll the two together, and on taking them apart the paper will be found perfectly flat and without creases. The inside of the roll is the right side to draw upon.

Have a draughtsman's pencil with renewable leads (the writer prefers A. W. Faber's No. 4), and to sharpen the point use fine sandpaper held to a piece of stiff millboard or thin wood, about 6in. by 3in., by means of a bull-dog letter clip (see Fig. 2). This should hang from one side of the trestles to within a couple of inches of the floor. Make use only of the lower part shaded in the sketch, and as the paper becomes worn out it may be cut off and moved down to the edge again. This arrangement has stood the test of practice, and will be found much better than a file or glass paper nailed on wood. Being so thin it can be easily employed for sharpening the leads of spring bows, etc.

Before beginning work, put lines on the paper to the standard size of drawing, and then, setting the T-square half-way up the board, make a mark about an inch long, at either side of the drawing, which will serve to set the paper by whenever it has to be pinned down again. This will be found much more satisfactory than trusting to centre lines for that purpose.

Drawing.—Always use a very sharp pencil, with a flat point, rather less than a sixteenth of an inch wide. A neat drawing is impossible if pencil or compass leads are not sharp. Centre lines should be preserved with the greatest care, and on important drawings they may even be indented with the back of a knife blade. They should never be wide or drawn with a soft pencil. The first rule of draughtsmanship is that all dimensions be taken from centre lines. Thus, if a line is 2in. from the centre, and it is desired to draw another 3in. beyond it, then in measuring for the second, place the scale so that it *crosses the centre line*, at the same time noticing that the figure on the scale, which in this case will be 5, comes exactly over the centre line. This practice deserves careful attention, as it is the secret of accurate drawing. Where there are many similar dimensions the spring dividers should be employed—as, for instance, in drawing the section of a bedplate they may be set to the thickness of the metal, and used instead of the scale. Dividers should also be used in making the same measurements on each side of a centre line—in drawing the section of a dynamo armature, for instance. When transferring dimensions, a great deal of time can be saved by marking several at a time on the edges of a piece of paper, and from thence upon the drawing. This method is not accurate, and should only be employed where exactness is unimportant. With a sharp knife cut up half-a-dozen paper strips, about 9in. by $\frac{3}{4}$in., and pin them to the wall. They can be torn down as wanted, and each will furnish four edges for marking.

The young draughtsman should remember that the only way to make tedious work interesting is to do it better than it has been done before. If work be scamped because it seems unimportant, the result will not be satisfactory to anyone. Make quality the first aim, and speed the second. To reverse the order is fatal to good work.

Designing.—Drawing consists in putting lines together in order to make a picture; designing, from the engineer's standpoint, is putting ideas together so as to plan a structure. The young draughtsman will soon be able to draw, as he can read or write, without thinking of the process, but his ability to design should never reach its limit, but should continue to grow as experience is gained. It is a good plan to take a common exercise book, with a paper cover, and make all calculations and rough sketches in it. This book will be found invaluable for reference, and much better than using odd scraps of paper, which can never be found when wanted. It is best to calculate the strength of everything that can be calculated, but in arranging metal it should be considered if other reasons than strength influence its proportions. This is especially important in castings, when the necessity of fairly uniform thickness, to ensure even cooling, will often make it necessary to use more metal than the mere strength requires. As far as possible the use of empirical formulæ for calculations should be avoided, especially in such straightforward work as the strength of beams, shafts, etc. In these matters "Unwin" will prove of greater assistance than "Molesworth." Graphic statics are useful for computing stresses in order to proportion the strength of structures, and for all roof work they are invaluable. In a simple matter, such as finding the bending moments in a beam, calculation is quicker. It is well to form a habit of noticing the relative sizes of machine details. Take Fig. 3 as an example. Let C be the unit, and by actual measurement from different machine tools find the average proportions of A, B and D in respect to C. Jot down the result in a note-book. This is only one instance. Many others will suggest themselves in the course of daily practice.

Books.—Molesworth's "Pocket Book," D. K. Clark's "Pocket Book," and Unwin's "Machine Design" may be considered absolutely necessary, and these will be sufficient for general work. In addition Hutton's "Works Manager's Handbook," Trautwine's "Pocket Book," Gray and Lowson's "Graphic Statics," and Perry's "Mechanics" may be procured. The above are all useful for general engineering work. Special branches, as electricity, etc, have a literature suited to the particular line. A thorough knowledge of decimals and the elementary rules of algebra is necessary to use these books. A draughtsman should be familiar with the use of logarithms, as they save much time and thought, and the slide rule is even a more valuable aid to the engineer. The writer can recommend the "Celluloid" slide rule, price 10s. 6d.

Sundry Notes.—Some standard articles, unfortunately, have very fractional dimensions, which makes it always a tiresome matter to draw them correctly. Bolt heads and nuts are cases in point. The rough-and-ready practice of making the width across corners of hexagon nuts equal to twice the diameter of the bolt is only correct for the $\frac{1}{2}$in. size, and therefore leads to serious mistakes in proportioning the width of flanges. It will be a great gain in speed and accuracy if a standard nut gauge be made, giving dimensions across the angles on one side, and across the flats on the other, for full, half, and quarter size. A gauge accurately divided for threads per inch will also be very useful, and one giving the top and bottom diameters of gas threads may be added. The arrangement of these gauges requires careful consideration, and the writer may, in a future paper with the Editor's permission, explain how to make the form he has found most convenient.

Templates cut out of thick paper may be used for drawing irregular forms, and are particularly useful when a large screw thread is to be shown with the correct curves, instead of being indicated by straight lines in the usual way.

The very simple method of dividing a straight line into any number of equal parts, shown in Fig. 4, does not seem sufficiently practised. To divide the line A B draw A C at any angle, and mark it with the required number of divisions of any convenient length. Then set the "adjustable set square" to the inclination of C B, and draw the other dotted lines parallel to it.

Even if liquid Indian ink be not always used, it should be available in every drawing office. The only disadvantage is that when dry it has not such a glossy surface as the stick ink, but this is hardly a serious matter. When ink has to be rubbed it should be done on a broken piece of school slate. Set squares are cleaned by rubbing them on drawing paper. The T-square will also need treating in the same way.

Erasures on tracing cloth, if required to be very neat, may be done with powdered pumice stone. Ordinarily a sharp knife is used. Never wash out anything on cloth.

The German round writing is not sufficiently known in England, although engrossing as practised by lawyers is something like it. It is the quickest ornamental writing, and is worth the trouble of learning.

The cheapest and best drawing pins are those with the point stamped out of a metal disc.

We are pleased to learn from Messrs. Bell's Asbestos Company Limited that the growth of their business has been such as to render it necessary to erect new and more commodious premises in Southwark-street The new address of the company will be Southwark Bridge House, Southwark-street, London, S.E. A special feature of the new premises will be an extensive showroom, in which machines of various kinds will be shown in operation, so that intending purchasers may have ample opportunity of selecting tools most suitable to their requirements.

The Institution of Civil Engineers.

At the opening meeting of the seventy-fifth session, held on Tuesday, the 8th inst., Mr. Harrison Hayter, the president, after distributing the medals and premiums awarded to the authors of papers dealt with during last session, delivered his inaugural address. He proposed to depart from established precedent, and to notice such works of importance as were likely in the not-distant future to be undertaken by British engineers, both at home and abroad, and also the principal fields of future employment.

One of the most prominent schemes was that projected to place England in unbroken railway communication with the Continent by a tunnel under the English Channel. The route proposed by the late Sir John Hawkshaw, Mr. J. C. Hawkshaw, and himself, in association with the late Sir James Brunlees and Mr. McKerrow, would leave the English coast about 4 miles north-east of Dover, and proceed in a straight line to the French coast near Sangatte, about 6 miles south-west of Calais. The tunnel would penetrate the lower chalk throughout, and there would be no "faults" materially to affect the continuity of the strata. The total length of the railway would be about 35 miles, of which about 21 miles would be in a submarine tunnel, the remainder being the approaches and connections on either side. The Channel Tunnel Company was exploiting a tunnel on a different line, the strata to be penetrated being, however, generally the same. The first question to be settled, however, was the political one.

Another project, which had already received considerable attention, was a tunnel to unite the English and Scotch railways with those of Ireland. Mr. James Barton and Messrs. Hawkshaw and Hayter laid before an influential meeting, held at Belfast in October, 1890, a project for a tunnel passing round the northern end of "Beaufort's Dyke," a ravine 3 miles wide and 900ft. deep, in the sea bed nearly parallel to the coast of Scotland, where the maximum depth of water was 500ft. The tunnel would be at such a depth as at no part to be nearer the bed of the sea than 150ft.

The results of the investigations as to the tunnels between England and France and Scotland and Ireland warranted the following conclusions:—1. A reasonable probability that the tunnels could be made. 2. The risk would be limited to the possibility of sea water finding its way into the workings in quantity too great to be overcome. 3. The question of risk would probably be solved by sinking the land shafts, which would form part of the permanent work on each coast, and by driving the permanent driftways. 4. The loss, if any, would thus be measured by and limited to the cost of the preliminary shafts and driftways. 5. There seemed to be no reason why these tunnels should cost more than £10,000,000 each, or take more than 10 years to complete. There were three other submarine tunnels which it was not improbable would be constructed before long; one to connect the railways north and south of the Humber, and to obtain for the southern lines a terminus at Hull; a second, about 1¾ miles in length, to unite the railways on either side of the Thames, at some point east of Purfleet; and a third, to connect the railways in the Isle of Wight with the London and South-Western, and so with all the mainland lines.

Turning to inland navigation, about one-third of the canals of the country belonged to the railway companies, who, in their own interests, had in many cases blocked through communication and connections in order to stop competition. There were indications, however, that canals would soon be placed on a more satisfactory footing. For cost of construction and maintenance and economy of transport, canals compared most favourably with railways, and the unsatisfactory position of our canals had enabled France, Belgium, and Holland to carry coal and heavy goods so cheaply as to handicap us in foreign competition. Since the passing of the Railway and Canal Traffic Act of 1888 many projects had been mooted, amongst which he might mention a canal from Birmingham to the Humber; one from Birmingham to Liverpool by means of the river Weaver and the Manchester Ship Canal; and a third from Birmingham to the Bristol Channel, *via* the Birmingham and Worcester Canal, the Severn, and the Canal from Gloucester to Sharpness: works were already in progress to effect the latter object. There had also been proposals to widen and deepen the canals between Birmingham and London, to connect the Tyne and Solway by a canal, and the Forth and Clyde by a direct ship canal, and to construct a ship canal between the Bristol and English Channels, *via* Bridgwater and Lyme Regis.

(To be continued.)

Metal Trade Memoranda.

The Steel Plate Mills at Bolton, which have been stopped for several weeks past, have now been restarted.

The directors of the Marbella Iron Ore Company report the output of ore for October to be 4234 tons.

The directors of the Wohlfahrt Lead Mines Limited have declared an interim dividend of 5 per cent. on account of the year 1892, tax free, payable on and after 15th inst.

During the month of October the Arizona Copper Company's mines produced 218 tons of black copper and 110 tons of matte. This is equivalent to about 295 tons of black copper.

131,000 tons of Gellivara iron ore have been shipped this summer from Lulea, Sweden. The daily output amounts to 1000 tons. The borings, which are still being carried out, have reached a depth of 126ft.

The Forest Steel Works, South Wales, commenced operations on the 7th inst. Three more mills will also start at the Worcester and Forest Tinplate Works, as well as the pickling machinery. The tin-house will probably be reopened in the course of a week or so.

The Swansea Steel and Tinplate Company has been formed in America, with a capital of £40,000. The plant will consist of four mills, and will be situated at St. Paul Park, near St. Paul, Minn. It is expected that the works will be in operation by June 1, 1893.

The Metal Market.

PRICES CURRENT.

LONDON, Nov. 14.

Copper was £42 2s. 6d. buyers, three months, at the opening, and early business was done at £46 7s. 6d., a gain of 5s. on Friday's official prices, but towards the close of the first call prices drooped to £46 6s. 3d., buyers showing less interest. Later in the day, however, renewed buying caused a sharp rally to £46 10s., the market showing strength on American cables reporting dissatisfaction on the part of the directors at the results of working the Montana Butte Mine and the possibility of its being closed. Three months advanced to £46 12s. 6d. after the official close, besides which £46 13s. 9d. was reported paid privately, and £46 5s. and £46 3s. 9d. were paid irregularly for cash and November dates. The close is firm at a rise of 11s. 3d. since Friday. Sales, 900 to 1000 tons. Settlement price, £46. English tough, £49 to £49 10s.; best selected, £50 5s.; strong sheets, £58.

Tin opened quietly, and under realisations lost 7s. 6d., early December and January dates passing at £93 12s. 6d. Values afterwards hardened to £93 15s. for January and sharp cash, consequent upon the good demand, especially for near positions, and in the afternoon further advanced, recovering to Friday's level of £94, which was finally paid for cash and three months. Sales, 270 tons. Settlement price, £94. English ingots, £97 10s.

Pig Iron was steady at the opening, with cash offerings at Friday's values, the best bid being 41s. 6½d. Later on holders raised their prices in sympathy with Glasgow advices, and this hindered business, but towards the close three months open, buyer's option, with three and seven days' notice, was done at 42s. 5d., and finally holders were disposed to make concessions. Sales, 1500 tons. Settlement prices:—Scotch, 41s. 10d.; Middlesbrough, 37s. 6d.; hematite, 46s. 9d. By committee notice posted to-day it is agreed to admit upon the list of brands Connal and Co.'s warrants for the "Skinningrove" brand. Middlesbrough, deliverable upon contracts under rules and regulations of this Exchange.

Tinplates are steady, with I.C. cokes, f.o.b. London, at 12s. 9d.; Liverpool, 12s. 3d.; Swansea, 11s. 9d.

Lead has been firmer, and business is reported in Spanish at £10 3s. 9d., an advance of 1s. 3d. English, £10 7s. 6d.

Spelter is easy and 1s. 3d. lower. November shipment, £18 15s., sellers.

Zinc Sheets.—Silesian are steady. Ordinary, £22 2s. 6d., ex ship. Belgian firm. V.M. brands, £22 5s., ex ship, £22 f.o.b. Antwerp.

Official Closing Quotations.

	£	s.	d.	£	s.	d.
Copper—						
G. M. B.—Cash	46	0	0	—46	7	6
" Three months	46	10	0	—46	17	6
English tough	—			—		
Best selected	—			—		
Strong sheets	—			—		
Tin—						
Fine foreign—Cash	94	0	0	—94	10	0
" " Three months	94	0	0	—94	10	0
Australian—Cash	94	10	0	—95	0	0
Pig Iron—					s.	d.
Scotch warrants—Cash					41	10
" One month					42	0
Middlesbrough—Cash					37	6
" One month					—	
Hematite—Cash					46	9
" One month					—	

GLASGOW, Nov. 14.—The forenoon proceedings on the pig-iron market were without feature, and only 3000 tons of Scotch sold; but at the afternoon session dealing in Scotch extended to 15,000 tons, and the tone at last was strong, 4s. 11d. cash being paid by local "bears," quite a number of whom were anxious to cover. A lot of business was done on 1s. forfeit basis at from 41s. 7d. to 41s. 10d., one month. There was nothing done in Cleveland or hematite. The Scotch shipments for last week were

5453 tons, being an increase on the corresponding week of last year of 351 tons, thus making the increase for the year 27,270 tons.

QUOTATIONS.

	Highest.		Lowest.	
	s.	d.	s.	d.
Scotch warrants—Cash	41	11	41	7
" One month _	42	1	41	8½
Middlesbrough—Cash.....	37	6	37	3
" One month ..	—		—	
Hematite—Cash	46	9	46	6
" One month _ ..	—		—	

Official Gazette.

Partnerships Dissolved.

J. BOURNE and F. BRADLEY, under the style of J. H. Wilson and Co., Sandhills, near Liverpool, engineers.

J. H. GEISENHEINER and E. A. LESSING, under the style of Watson. Geisenheiner and Co., Glasshouse-street, electrical engineers.

J. BAKER, T. BAKER, jun., and J. K. BAKER, under the style of J. Baker and Sons, Sheffield, steel and file manufacturers; as far as regards Joseph Baker.

THE BANKRUPTCY ACTS, 1883 AND 1890.

Adjudication.

E. YATES, Leeds, mechanical engineer.

Receiving Orders.

E. PERCY, Scarborough, brass founder and plumber.

E. J. HARRIS, Smethwick, late in partnership as W. R. Brookes and Co., as manufacturers of sheet iron; merchant.

New Companies.

W. WEEKS AND SON LIMITED.—This company was registered on the 4th inst., with a capital of £25,000, divided into 5000 shares of £5 each, to acquire and carry on the business now carried on by Edmund Gascoine, under the name or style of W. Weeks and Son, at the Perseverance Ironworks, Maidstone, as engineers, iron and brass founders, and makers of all kinds of agricultural implements, etc. The number of directors is to be determined by general meeting; qualification, £500; remuneration to be fixed by the company in general meeting. Registered by Mr. Thomas Bore, 14, Ropemaker-street, E.C.

JULIUS SAX AND CO. LIMITED.—This company was registered on the 28th ult., with a capital of £20,000, divided into 2000 shares of £10 each, to acquire the business of Julius Sax and Co., carried on by Messrs. Alfred and Charles W. Sax, and the lands, factories, warehouses, and effects connected therewith; to carry on the business of supplying electricity in all its branches, and to construct, lay down, establish, fix, and carry out all necessary cables, works, lines, accumulators, lamps, works, and to generate, accumulate, distribute, and supply electricity, etc. The number of directors is not to be less than 2, nor more than 5; qualification, £1000 in debentures; remuneration, any sum not exceeding £500. Registered by Mr. W. B. Styer, 2, Threadneedle-street, E.C.

NEW BRITISH ELECTRIC INSTALLATION CONTRACTORS LIMITED.—This company was registered on the 29th ult., with a capital of £25,000, divided into 5000 shares of £5 each, to acquire, carry on, develop and extend the business heretofore carried on at Worcester by the British Electrical Installation Contractors Limited, and to enter into the agreement mentioned in the 4th clause of the articles of association, to carry on the business of electricians, electrical and mechanical engineers and contractors, and to take the lighting of streets and other places, public or private; and to produce and supply electricity generally. The number of directors is not to be less than 3, nor more than 5; the first being appointed by the subscribers to the memorandum of association; qualification, £5; remuneration, £250 per annum. Registered by Mr. Richard Jordan, 120, Chancery-lane, W.C.

COAL-BRICK SYNDICATE LIMITED.—This company was registered on the 1st inst., with a capital of £150,000 in 150,000 shares of £1 each, to apply for, purchase, or otherwise acquire any patents, patent rights, brevets d'inventions, concessions, and the like conferring an exclusive, or non-exclusive, or limited right to use, or any secret or other information as to any invention which may seem capable of being used for any of the purposes of the syndicate, or the acquisition of which may seem calculated, directly or indirectly, to benefit the syndicate, and in particular any invention in any way relating to the utilisation of coal dust, and for such particular purpose to adopt an agreement for acquiring from Mr. T. W. Lee the benefit of certain patented or protected inventions and future inventions of the like nature, and for a similar purpose to carry on all or any of the businesses of briquette machine manufacturers, colliery proprietors, coke manufacturers, ironmasters, ironfounders, steel makers, etc. Until otherwise determined by a general meeting, the number of directors is not to be less than 2, nor more then 7; qualification, £100; remuneration, £1500 per annum, and 20 per cent. of the amount distributed amongst the shareholders as dividends or bonus. Registered by Mr. J. C. Savory, 26 and 27, Bush-lane, E.C., solicitor.

Trade Marks.

The following is the Official List of Applications published from November 2 to November 9, for the Registration of Trade Marks, so far as relates to the Metal Trades.

CLASS 5.

HYPATIA

167,355. Bloom, bar, and sheet iron, and other unwrought and partly wrought metals used in manufacture. BENJAMIN GREENWAY SOUTHALL, Field-street, Hallfields, Bilston; iron and steel merchant.—26th September, 1892.

CLASS 5.

167,039. Bar iron and bar ends (iron). SKINNSKATTEBERGS BRUKSEGARE, Skinnskatteberg, Sweden; iron manufacturers.—12th September, 1892. Mark used by applicants and predecessors in business since 1865. *Address for service in the United Kingdom*, care of the Trade Mark Owners' Mutual Protection Association Ltd., 17 and 18, Basinghall-street, London, E.C.

CLASS 5.

167,010. Bar iron and bar ends (iron). SKINNSKATTEBERGS BRUKSEGARE, Skinnskatteberg, Sweden; iron manufacturers.—12th September, 1892. Mark used by applicants and predecessors in business since before the year 1748. *Address for service in the United Kingdom*, care of the Trade Mark Owners' Mutual Protection Association Limited, 17 and 18, Basinghall-street, London, E.C.

CLASS 6.

"*The essential particular of the Trade Mark is the following:—The device of the lion rampant, and the applicants disclaim any right to the exclusive use of the words 'Lion Brand.*"

156,953. Non-frictional metal bearings, being parts of machinery other than horticultural or agricultural machinery. ANDREW BARCLAY, SON AND CO., Caledonia Works, Kilmarnock, Ayrshire; engineers.—12th June, 1891.

CLASS 6.

"*The essential particular of the Trade Mark is the device, and the applicants disclaim any right to the exclusive use of the added matter.*"

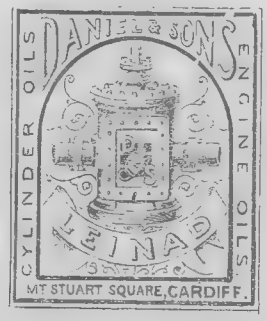
166,623—2827 S. Machinery of all kinds and parts of machinery (except agricultural and horticultural machinery included in Class 7), including machine knives and machine tools. COLVER BROTHERS LIMITED, Pilot Works, Sheffield; manufacturers.—20th August, 1892.

CLASS 13.

"*The essential particular of the Trade Mark is the device, and the applicants disclaim any right to the exclusive use of the added matter.*"

163,635—2834 S. Metal goods not included in other Classes. JONAS AND COLVER LIMITED, Continental Steel Works, Attercliffe, Sheffield; manufacturers.—20th August, 1892.

CLASS 47.



"*The essential particulars of the Trade Mark are the device and the word 'Leinad,' and the applicants disclaim any right to the exclusive use of the added matter, except their name and address.*"

166,547. Lubricating oils for cylinders and engines. DANIEL AND SONS, 8, Mount Stuart-square, Cardiff, Glamorganshire; oil merchants.—16th August, 1892.

CLASS 50.

BULL DOG

167,114. Belting wax, being a composition for preserving machine belts and preventing them from slipping. JAMES GIBB AND CO., 99, Fenchurch-street, London; brassfounders, engineers, and contractors.—14th September, 1892.

THE large steamship "Longships," which has been built to the order of the Clyde Steam Shipping Company by Messrs. W. B. Thompson and Co. Limited, Dundee, was successfully launched on the 5th inst. The dimensions are:—Length, 394ft.; breadth, 46ft. 6in.; depth of hold, 27ft. 6in. Her gross tonnage is 4450, and she is fitted with triple-expansion engines with cylinders 26½in., 42in., and 69in. in diameter.

Letters to the Editor.

*** *We do not hold ourselves responsible for opinions expressed by correspondents.*

*** *The name and address of the writer (not necessarily for publication) must in all cases accompany letters intended for insertion, or containing queries.*

*** *Letters intended for publication in the current week's issue must reach our Manchester Office not later than by the first post on the Tuesday preceding the date of publication.*

ELMORE'S DEPOSITED COPPER TUBES.

To the Editor of THE MECHANICAL WORLD.

SIR,—I find that the results of tests of Elmore's deposited copper tube given in my "Mechanical Engineer's Pocket Book" (published by Crosby Lockwood and Son) are repudiated by Messrs. S. and T. Elmore on behalf of their Company, and I shall feel much obliged if you will allow me to mention the matter in your columns; the results in question will therefore be duly omitted in the next edition of the "Pocket Book." Thanking you in anticipation for the insertion of this letter.

London, Nov. 14. D. K. CLARK.

THE GYROSCOPE.

To the Editor of THE MECHANICAL WORLD.

SIR,—Being interested in the action of the gyroscope, I went to hear Mr. Morrison's lecture last week on the above subject, but he did not enlighten me in any way. What he said I can understand, and his explanation appears to be rational; but it has the defect that nothing of the kind is to be found in the text-books. He, in common with Mr. Sharp, holds that stability is secured by the effort of the disc to revolve round a new axis. Everyone says this, and accepts the explanation as quite satisfactory. Let us suppose for a moment that the gyroscope did revolve round a new axis: Why should the whole of its weight be transported to the central support? Then Mr. Franks's notions about a couple are, to say the least, peculiar. The idea that the force of gravity can be neutralised by the upward thrust of a post 10in. away from the centre of gravity, and only these two forces being in action, is simply absurd on the face of it. Where is the third force? I read Professor Perry's delightful book on "Spinning Tops" with much pleasure, but he does not explain why a top stands up, much less a gyroscope. Perhaps, after all, Mr. Morrison is right; but as I do not know his address, and I remember he stated in the hall that he read your paper, I take this mode of addressing him. J. S. WILKIE.

Dundee, Nov. 7.

Miscellaneous Items.

A buoy, which is to be lighted by electricity, is being placed on the Hen and Chickens Reef in the Forth, near Bo'ness.

A new railway is to be constructed in Turkey, from Salonica to Dedeabatch, a distance of 312½ miles. The line is to be laid with steel sleepers.

The Prescot watch factory at Prescot, Lancashire, is being installed with electric light. The installation will comprise 1500 lights.

Important works are to be commenced shortly at Havre, in order to render the port accessible to large ocean steamers during six hours of every tide, and to enlarge the entrance to the harbour.

The first train on the Liverpool Overhead Electric Railway was run on the 8th inst., carrying the directors and their friends. The trip was very satisfactory, the working of the main engines and dynamos being all that was anticipated.

Among the Russian exhibits destined for the Chicago Exhibition is a locomotive belonging to the Moscow and St. Petersburg (Nicolai) Company. This is a new express engine now being completed at the Alexandrovsk Works, where all the workmen and artificers are Russians.

The annual report of the Minister of Mines for New Zealand states that the production of gold last year greatly exceeded the quantity obtained for several years previously, while the output of coal is steadily increasing. The quantity of gold exported for the twelve months ended March last was 276,535oz., of the value of £1,107,177. The output of coal was 668,794 tons. The total value of mining products was £1,840,686.

According to a return issued by the Board of Trade regarding railway communication between London and great towns, the highest average speed attained by the trains on the different lines is as follows:—Great Western, 45 miles per hour,; London and North-Western, 47; Great Northern, Midland, 51; London, Brighton and South Coast, 43; Great Eastern, 38 [illegible] and South-Western, 37.

Camphor trees have abounded in great numbers in Iki Island, Japan, and since the profitableness of the manufacturing of camphor has become known, the number of factories has of late years rapidly increased. One result of the great increase is that grown trees are becoming exhausted. Fortunately, however, the young trees are very numerous, and if steps are at once taken to put their cultivation on a proper basis, the industry may be saved from extermination.

An improved platen machine of the Universal type is announced from Germany, the invention of a Frankenthal engineer named Hamm. In order to obtain a better distribution of ink for fine art purposes, the rollers revolve in a carriage rotating right round the type bed, which is the shape of the letter D, the curved part of the letter representing the distributing disc, which has two continuous revolving feeding rollers. The machine gives a very solid impression, but cannot be worked at any fast speed.

Queries.

☞ Readers are invited to avail themselves of this section for practical information on questions relating to Mechanical Engineering and the Scientific Industries.

☞ Queries and Replies should arrive at the Manchester Office not later than by the first post on the Tuesday preceding the date of publication.

PNEUMATIC RIVETING MACHINES.—Required the address of makers of pneumatic riveting machines.—W. G.

CASTINGS.—Can any reader inform me how to secure clean castings which have wrought-iron pieces "cast in."?—L. U.

SPEED OF DRIVE CHAIN.—Can any reader give me any particulars as to the safe speed at which Ewart's patent chain may be run?—SECOND MOTION.

CONVERTING GAS ENGINES.—Will any reader kindly inform me how to convert a Crossley's gas engine, 15H.P., slide-valve type, to a tube firing type?—FITTER.

SWEDISH BESSEMER STEEL.—Can any reader inform me how Swedish Bessemer steel is made, and also give highest amount of carbon it contains?—FORGEMAN.

COATING FOR WATER PIPES.—Can any reader tell me how to ascertain whether cast-iron pipes have been properly coated with Dr. Smith's solution?—WATER PIPE.

MOULDING SAND.—Will any reader inform me where the fine moulding sand is obtained which is used for making small malleable-iron castings in Walsall?—IRON FOUNDER.

PRESSED PAPER.—I shall be obliged if any reader can furnish me with names of firms in England or abroad who press paper for making trays, wheels, teeth, etc., and the widening circle of articles now made of compressed paper or pulp.—A CONSTANT READER.

HARDENING AND TEMPERING.—Can any reader inform me how to harden and temper a number of straight steel wires 13 gauge and 16in. long? I have tried several ways, but I cannot keep them straight. I may say that I have hardened them in oil, and one at a time.—BLACKSMITH.

LOSSES IN STEEL FURNACES.—Could any reader kindly inform me the average per cent. of actual loss, and the average per cent. of skull, in the charge of a Siemens open-hearth steel furnace working charges of from 30 to 40 tons? And also the percentage of loss in heating slabs and ingots in the Siemens regenerative gas furnace?—J. R. R.

Replies.

☞ Owing to the constant increase in our correspondence, we regret that we have no alternative but to announce that we cannot reply by post to Queries even when stamped envelopes are sent.

☞ Queries and Replies must in all cases be accompanied by the names and addresses of the writers, as no notice will be taken of anonymous communications.

J. THORNTON.—See reply to "Member."

COUNTRY.—These will be treated of in due course.

C. PERCIVAL.—You have omitted to give your address.

J. E. COX.—Write to Mr. Phillips, who will give you full particulars.

J. K. H.—We cannot give the sketches even if we had space to spare.

BLACKSMITH.—Apply to Mr. William Ryder, Bee Hive Works, Bolton.

JACK.—(1.) Fill it. (2.) Forcing more water into the cylinder. (3.) Water, yes.

L. D.—Apply to Mr. Forkner, Leicester, who is a large maker of this class of machine.

R. WALLACE.—Any maker of china or earthenware in Hanley will be able to supply you with tea strainers.

F. B.—Apply to the Assistant Secretary, Commercial Department, Board of Trade, Whitehall, London, S.W.

J. PAGE.—If you write to R. R. Minton and Co., Briggate, Leeds, they will supply you with any quantity of luminous paint.

MEMBER.—The secretary of the Institute of Mechanical Engineers will give you full particulars upon application to 19, Victoria-street, Westminster, London, S.W.

STUDENT.—We cannot give any rule for nominal horse-power which is better than that you already have. The whole subject was fully discussed in our issues for April 6 and 13 last.

J. S. C.—At the pressure you give, about 40lb. of steam per minute will flow through a 1in. pipe into the atmosphere. There are no data [illegible] the flow of steam into water so far as we are aware.

CAST-IRON SASH WEIGHTS.—If C. R. Roberts will write to W. F. Crowther, iron moulder, 70, [illegible] Grove, York, he will give him what information he requires for casting sash weights in chills.

SEAGOING.—First-class passengers are allowed about 60 cubic feet of luggage space, intermediate between 20 and 30 cubic feet. Steerage passengers are considered fortunate if they get any space at all.

T. P. A.—A Kingston valve is a wing valve used on shipboard for the suction of the condenser water, and for boiler blow-off. It opens towards the sea, but is self-closing in the event of the spindle breaking.

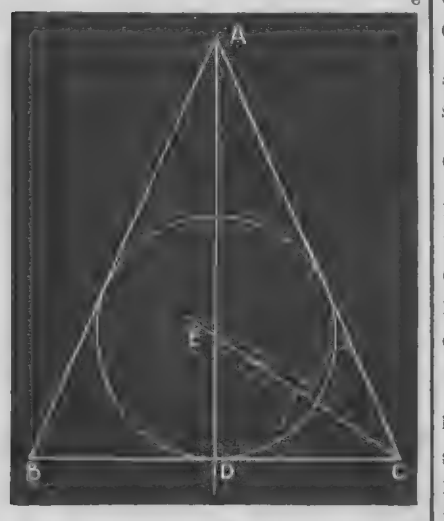
BALANCE.—It is the best practice to balance the pulley. Of course any eccentric weight will destroy the balance; but that is no reason why the pulley should not be balanced in the first place.

DYNAMO.—The area to be used in the calculation is the unbalanced area, or the difference of the areas exposed to pressure on the two sides, providing the pressures are alike. If you are not quite clear, send us a sketch of the valve.

BRICK MANAGER.—Electric heaters are new to this country, and but little reliable data are available. Possibly Messrs. Woodhouse and Rawson United Limited, 88, Queen Victoria-street, London, may be able to give you some information.

INDICATOR.—Your engine is developing about 175 H.P. The clearance must be known before the expansion curve can be compared with the standard curve; but it does not appear from the diagrams that the piston allows steam to pass to any great extent. Take off the back cover and block the engine in position to give steam on the other side of the piston, and you will soon be able to ascertain the extent of the leakage.

GEOMETRY.—Will any reader give a rule for the diameter of the largest circle which can be drawn within an isosceles triangle?—*A.*—Let A B C be an isosceles or any triangle. Draw A D perpendicular to one side B C from angle A. Bisect the angle A C B, and draw C E, ing A D in E. E is the centre of the



inscribed circle—necessarily the largest which can be drawn within it. The diameter of this is twice E D. Trigonometrically the diameter is found thus:—

$$B C \times \tan \frac{\text{angle A C B}}{2} = \text{diameter of circle.}$$

—T. J. B.

FLANGING PLATES.—Will any reader kindly let me know which is the best way to flange plates 2ft. 6in. diameter by $\frac{1}{16}$in. thick? I must flange them by hand, as we have no flanging machine?—BOILER.—*A.*—We will suppose your plates are cut to the required size for flanging, and the centre marked for the required width of the flange: Get a short piece of iron-set rod, the same thickness as the plate to be flanged. Bend it round the centre pops so that the outside of the set-rod is even with the centre pops. Now procure a piece of metal block about 2ft. 6in. long, and of the same radius as the inside of your set-rod, and of sufficient depth so that the edge of the flange will not come in contact with anything in being bent over the block. If your block has not sufficient weight in itself to lie solid, drill some holes in it and secure it to a piece of thick plate so that it will be firm and solid, and be sure that the edge of your flanging block is slightly rounded; never flange over a sharp edge. Having got your plate and block ready, proceed to get your fire right for flanging. Build the fire to the same radius (with damped coals) as your flanging block, and not too long, say about 2ft. 4in., which will be as much as you will be able to flange at one heat. Having got your fire ready, set your plate on the block you intend to flange it over, with the centre pops projecting about the thickness of the plate over the block. If you could put a hole in the centre of the plate and have a centre pin attached to the plate that is secured to the block, it would be more easy and save a lot of trouble, as you could drop the plate in its right position at each heat; but if the plate must remain whole, place some pieces of wood under the plate to keep it level, and have a bearance on the edge of the block. Drive two or three pieces of angle bar into the shop floor as a guide for you to lay the plate in position when hot. Watch that the plate does not creep over the block when you begin to hammer, for if the plate creeps over it will bring the centre pops too low down, and then your plate would become too small. Make a few marks with a piece of chalk before putting the plate into the fire, so that you can see at a glance when you bring the hot plate out where to lay it; now place your plate on the fire for the first heat, and heat as little of the plate behind the centre pops as possible. When the plate is hot, bring it out and place it in the same position as it was when you marked it with the chalk; with light hammers or wooden mallets (which will do for light plates like the one under notice) commence to bend, or flange as it is called, and when you have bent the plate over square with the hammers, take your flat-face, or flatter, and go nicely round the part you have just flanged, being particular about making a nice even face all along the pops without any hammer marks being left in the part just done. You have then finished your first heat. Now shift the plate round a little for the next heat, and be sure you have a part of the flange already done pressing against the block, and drive a piece of angle bar at that particular place to keep it against the block. Mark with your chalk again the position of the plate, as in the first heat. Place in the fire again, and reheat a little of the flange already done, so that it will give easy at the junction of the two heats, and it will also prevent it from puckering. As the edge of the flange will be deepest in the fire when taking your second and following heats, be careful that there are no pieces of coke in contact with the edge of the flange, as it will burn at that place first. If you get your second heat all right, the rest will be all the same. Try to get all the heats about the same width, so that they may have the same uniform radius round the root of the flange; try to have it right at first, as it never looks nice if you have to keep altering. Your plate will twist before you have done with it; but never mind that, you can easily level at the furnace when finished.—BOILER MAKER.

Latest Inventions.

APPLICATIONS FOR LETTERS PATENT.

When Patents have been "communicated," the name of the communicating party is printed in italics.

Where complete specification accompanies application, an asterisk is suffixed.

31st October, 1892.

19,490 MOULDERS' STUDS, CHAPLETS, and CORE SUPPORTS. T H Thoms.
19,496 ELECTRO MAGNETS and MAGNETIC CIRCUITS. W Lowrie.
19,497 ELECTRIC LAMPS. H Clegg.
19,501 OBTAINING MOTIVE POWER. H J Shawcross and A W Brightmore.
19,504 WATER CIRCULATING APPARATUS for STEAM BOILERS. D B Morison.
19,521 METAL-CUTTING SAW. W Hartmann.
19,527 SCREEN GRIDS for SCREENING COAL, COKE, GRAVEL, ETC. F Silvester.
19,533 COKE DIGGING FORKS. A E Stayner.
19,534 TUBE PLATES for BOILERS. J H Heck.
19,540 TINPLATE-WORKING MACHINES. W Waller.
19,541 VARIABLE TRANSMITTING GEARING.* C A Allison. (*H C Behr*, United States.)
19,543 ELECTRIC INDICATING APPARATUS. L B Stevens.
19,544 CHARGING and DISCHARGING VESSELS CARRYING PETROLEUM. B Redwood and H W Lowick.
19,545 TUBE EXPANDERS. J C Bauer.
19,547 MICROPHONES. R Damseaux.
19,554 WRENCHES or SPANNERS. G Hodgkinson.
19,569 ELECTRICAL CONNECTIONS. O Fergusson.
19,575 TRACTION ENGINES and ROAD ROLLERS. F J Burrell.
19,576 NIGHT SIGNALLING AT SEA.* W Robson.

1st November, 1892.

19,587 TREATMENT of SEWAGE and POLLUTED WATERS. F P Candy.
19,591 VALVES. W Hartcliffe.
19,592 METAL WHEELS. J H Aston.
19,600 APPARATUS for CHARGING FURNACES WITH METAL.* J Buchanan, jun.
19,601 BAND SAWS for CUTTING METALS COLD. C Cornes.
19,602 ELECTRIC SWITCHES.* A B Blackburn.
19,603 LUBRICATING the JOURNALS of RAILWAY CARRIAGES.* P M Justice. (*B Edgar* and *R J Thomas*, United States.)
19,606 OIL SPRAYING or ATOMISING DEVICES or GAS APPARATUS.* C R Collins.
19,607 CUTTER HEADS for GROOVING and TONGUING BOARDS. J and A Gray.
19,611 PRODUCTION of STEAM. A Gray and J W Newall.
19,623 PROPULSION of BOATS. P dit A Laforesterie.
19,630 APPARATUS for USING LIQUID FUEL for LIGHTING and HEATING PURPOSES.* H Galopin.
19,632 KEYS for the PERMANENT WAY of RAILWAYS. T H Heard and W G Birkinshaw.
19,637 PRESSES for FORMING PIPES of MATERIAL in a DUCTILE or PLASTIC CONDITION. J C Etchells.
19,639 RAILWAY TRUCK COUPLING. W Bunyan.
19,643 CONCENTRIC STEAM JOINTS.* J B Morgan and H Adams.
19,646 SUPPLYING ELECTRICAL ENERGY of REQUIRED POTENTIAL to ELECTRIC CURRENT CIRCUITS. W Lowrie.
19,655 MEANS for HEATING by ELECTRICITY.* H G O'Neill.
19,657 UNDERGROUND CONDUITS for ELECTRIC CABLES. R Ewing.
19,658 APPARATUS for HEATING RAILWAY TRAINS. J E Howard.
19,665 TELEPHONIC APPARATUS. G S Hooker.
19,666 PEELS for CHARGING and DISCHARGING FURNACES. J W Booth.
19,671 CONDUCTING ELECTRICITY for ELECTRIC LIGHTING.* M W Pollard.
19,673 ARMS of SEMAPHORE SIGNALS. W C S Chapman. (*A D Chapman*, Cape Colony.)

2nd November, 1892.

19,690 DISTRIBUTION of CURRENT in INCANDESCENCE ELECTRIC LIGHT CIRCUITS. O A Enholm.
19,693 SELF-ACTING TURNING MACHINES. J and M H White.
19,695 MECHANISM for IMPARTING INTERMITTENT MOTION to MACHINERY. A Partridge.
19,705 APPARATUS for CONTROLLING the SPEED of FLUID-PRESSURE ENGINES. W H Northcott.
19,709 APPARATUS for INDICATING the DRAUGHT of SEA-GOING VESSELS. H Sutherland.
19,713 MACHINERY for SWAGING WIRE. W H Dayton.
19,714 DYNAMO ELECTRIC MACHINES. H Chitty.
19,715 AUTOMATIC RETURNING DEVICE for STREET and STATION INDICATORS.* M Anthony.
19,723 STEAM or FLUID-PRESSURE MOTORS.* P M Justice. (*E A Edwards* and *C L Doughty*, United States.)
19,727 PROCESS for the ELIMINATION of SULPHUR and PHOSPHORUS from MOLTEN IRON or STEEL. H J Phillips.
19,729 RECTIFYING ALTERNATING CURRENTS for WORKING CONTINUOUS-CURRENT MOTORS. C Pollak.
19,730 DISTRIBUTING BOXES for ELECTRIC LIGHT. G J Philpott and A J Willett.
19,734 APPLIANCE for SPRAYING OIL or LIQUID HYDROCARBONS USED as a SOURCE of MOTIVE POWER for GENERATING STEAM. E H Birley.
19,735 VALVES. F W Scott, jun.
19,738 PORTABLE ELECTRIC SAFETY LAMPS. The Edison and Swan United Electric Light Company Limited and E A Gimingham.
19,739 ELECTRICAL SWITCH. E L Joseph.
19,745 "EXCELSIOR" OIL PURIFYING APPARATUS. C H Freyer. (*F Korn*, Germany.)
19,750 RAILWAY SIGNALS. G G Byrne and E F Gascoine.
19,753 APPARATUS for the MANUFACTURE of WATER GAS. A G Glasgow.
19,755 PRESSURE GAUGES. A G Glasgow.
19,756 CONVERTING HYDRAULIC FORCE from ONE DEGREE of PRESSURE to ANOTHER. W Lowrie.
19,757 SECURING PULLEYS in THEIR POSITIONS. W Lowrie.
19,758 ELECTRIC CONDUCTORS. W Lowrie.
19,761 OBTAINING ELECTRICITY on BOARD SHIP. H R Maltby.
19,762 PLANES. R Sims.

3rd November, 1892.

19,765 INSTANTANEOUS SMOKE CONSUMING DOOR. E Cole and B Austin.
19,768 MAXIMUM and MINIMUM THERMOMETERS.* E Westbrooke.
19,769 CYANIDE PROCESSES for EXTRACTING PRECIOUS METALS from ORES. E Hunt. (*B Hunt*, Mexico.)
19,771 TELEPHONIC INSTRUMENTS. J Muirhead.
19,772 PROTRACTOR APPARATUS for RULING OFF ANGLED LINES. H R Kerr.
19,779 METALLIC PACKING for TAPS, STOP and LIFT VALVES, ETC. J Conlong.
19,781 PROPELLER SHAFTS of STEAMSHIPS. D B Morison.
19,784 GEARING FRONT-DRIVING VELOCIPEDES. R O'Driscoll.
19,785 PURIFYING SEWAGE and TRADE EFFLUENTS. W Oldfield.
19,786 SAFE WORKING of CAGES in MINES. J Haggie.
19,795 RIVET-HEADING MACHINES. G M Goose.
19,801 PICKLING and PREPARING IRON or STEEL PLATES for TINNING or GALVANISING. W S Rawson and Woodhouse and Rawson United Limited.
19,808 VALVES. T Walker.
19,809 METALLIC PACKINGS for PISTON RODS. T Walker.
19,818 MECHANICAL HAMMERS. E Hammesfahr.
19,821 ALTERNATE CURRENT TRANSFORMERS for VARIABLE LOADS. Siemens Bros. and Co. Limited. (*Messrs. Siemens and Halske*, Germany.)
19,822 AIR COMPRESSORS. W A Rohr.
19,823 APPLIANCES for PROTECTING the FIRE TUBES and TUBE PLATES of TUBULAR STEAM BOILERS. E Petersen.
19,825 GRAVITY ATTACHMENT for FIXING on NUTS SCREWED on BOLTS, ETC., to PREVENT the NUTS or BOLTS from UNSCREWING. G L Davies.
19,829 APPARATUS for PURIFYING WATER. L Archbutt and R M Deeley.
19,830 APPARATUS for PURIFYING WATER. L Archbutt and R M Deeley.
19,833 STEAM BOILERS. F T Stevens.
19,834 TELEPHONIC SWITCHING APPARATUS. A R Bennett.
19,836 STEAMSHIPS or VESSELS for CARRYING OIL. F Lane and others.
19,838 WATER SUPPLY SYSTEM.* J K Leedy.
19,840 MACHINES for CUTTING or SHAPING WOOD and METAL. C Morehead.
19,841 PROCESS for the RECOVERY of GOLD and SILVER and UTILISATION of BY-PRODUCTS from ORES CONTAINING the SULPHIDES of ANTIMONY, ARSENIC, TIN, ZINC, LEAD, and COPPER. H S Denny and J T Garrick.
19,845 RECOVERY of GOLD and SILVER from THEIR ORES. H S Denny and J T Garrick.

4th November, 1892.

19,847 BAND-SAW GUIDE. W S Worssam. (*P Pryibil*, United States).
19,851 PORTABLE SMOKE CONSUMING APPLIANCE for USE in CONNECTION with STEAM GENERATOR FURNACES. R Wallbank and C Sharples.
19,852 APPARATUS for MANUFACTURING BOWLS and ROLLERS from COMPRESSED LIGNEOUS MATERIALS. J Oliver.
19,853 NUT BLANKS. W Miller.
19,855 LIGHTING of RAILWAY TRAINS. S A de Normanville.
19,857 VALVES EMPLOYED to PREVENT the ACCUMULATION of WATER in PIPES. F A Russell.
19,858 APPARATUS for REGULATING the ACTION of FURNACES. T Gilmour.
19,859 AUTOMATIC SWITCHES for OVERHEAD RAILS USED for the TRANSMISSION of GOODS. A Kesson and others.
19,861 INJECTOR.* O Lindemann.
19,862 SHUT-DOWN FERRULES and TAPS for LIQUIDS. W W Harverson.
19,874 APPARATUS for REGULATING the SUPPLY of ELECTRICAL ENERGY to LAMPS. E P Davis and A C Cellins.
19,880 PRODUCTION of an IMPROVED ANODE for USE in ELECTROLYTICAL PROCESSES. T Parker and A E Robinson.
19,881 APPARATUS for CONTROLLING ELECTRIC PRESSURE in ALTERNATING CURRENT CIRCUITS. P W d'Alton and J A Fleming.
19,886 MAKING HOUSE CONNECTIONS with ELECTRIC LIGHTING MAINS. W Fuller.
19,894 SIGNALLING APPARATUS for USE in ENGINE ROOMS.* H H Lake. (*American Range-Finder Company*, United States.)
19,899 BOILERS for the HEATING of WATER or OTHER LIQUIDS. G Milton and W J Jones.
19,900 DEVICE for SCREWING and UNSCREWING NUTS. H Rowell.

5th November, 1892.

19,910 REFLECTORS for ELECTRIC LAMPS. P G Ebbutt and J B Verity.
19,912 STEAM BOILERS. P Pinckney.
19,916 ELECTRICAL CONDUCTORS. C T J Vautin.
19,919 ELECTRIC LIGHT CONDUCTORS. G F de Solomé.
19,922 STEAM BOILERS. G V Priestley.
19,925 STEAM BOILERS. G V Priestley.
19,925 APPARATUS for FILTERING or PURIFYING the FEED WATER of MARINE BOILERS. A Harris.
19,927 MEANS for LIGHTING RAILWAY CARS by ELECTRICITY.* J Körner.
19,941 FEEDING and STOKING of STEAM BOILER FURNACES. F Paget.
19,943 TOOL for FACING METALS for USE WITH ORDINARY TWIST DRILL.* A Cochrane
19,953 CONSTRUCTION of ELECTRODES for ELECTROLYTIC PURPOSES. J C Richardson.

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FRIDAY, NOVEMBER 25TH, 1892.

Milling Large Spur-wheel Teeth.

ALTHOUGH the system of transmitting power in mills and workshops by ropes has greatly increased in favour during the past few years, there is much evidence that spur gear is still greatly appreciated, and that the time has not yet arrived when it will be altogether discarded for the purpose we have named. The merits of both systems have been discussed in these pages from time to time by the advocates of each, and it is not our intention to again enter into the subject at the present time. Our more immediate purpose is to draw attention to the importance of milling the teeth of large spur-driving wheels. As is now well known, these wheels are most usually constructed with a heavy cast-steel rim, put together in segments, and it is also a matter of common knowledge that in the casting of these segments the pitch of the teeth is liable to vary very considerably, in addition to which the faces and flanks of the teeth are usually very rough. Needless to say that with conditions such as these it is impossible to obtain that perfect smoothness in running which is so essential to good driving in large wheels of this class, and it is with pleasure that we again refer to a system of milling the teeth of large spurs which has now been used for a considerable time with the most satisfactory results by Messrs. Scott and Hodgson, of Guide Bridge, Manchester. This firm now mill all the heavy wheels and pinions produced by them. The wheel, the teeth of which we had the pleasure of seeing cut some few weeks ago, was designed to transmit 1200I.H.P., at 42 revolutions per minute, its total weight being 46 tons. It has a cast-steel rim, built up in segments, being 18in. wide on face, and having 150 teeth of 5in. pitch. This ponderous mass was placed on a horizontal circular table carried by ball bearings, and capable of being rotated by worm gear in accordance with the pitch of the wheel teeth. At one side of the table a strong vertical framing is placed carrying the milling cutter. This is composed of a circular disc or milling head carrying a number of flat steel cutters trued up to gauge to the contour it is desired the teeth should have. The wheel is set, and the milling head traversed downwards so as to cut the opposite faces of two teeth and the bottom between them. On reaching the lower side of the teeth the milling head is traversed back to the starting point, the wheel rotated the extent of the pitch, and the cutters set to work again. We may mention that a roughing cut is taken first all round the wheel, and then a finishing cut. By these means the pitch is made absolutely uniform, and the teeth all of the same contour, so that in running there is very little noise, whilst at the same time breakages of teeth are rendered less frequent. We understand that Messrs. Scott and Hodgson are continually milling wheels of all practicable sizes. The advantages of cut gearing are so self-evident that we need not dilate upon them. There is, we think, very little doubt that only by the use of cut gears with short teeth can large amounts of power be transmitted at high speeds.

Electrical Legislation.

IN proposing the toast of "Our Guests," at the annual dinner, a week ago, of the Institution of Electrical Engineers, Prof. W. E. Ayrton, the president, coupled with it the name of Mr. Mundella, M.P., who, he remarked, had by the Electric Lighting Act of 1888 made electric lighting commercially payable, and he was therefore entitled to their warmest regards. Mr. Mundella admitted, as had been observed by the professor, that the Board of Trade might have given electrical engineers some trouble, but he disclaimed any personal responsibility in the matter. Though the first Act controlling the electrical industries —that of 1882—was too restrictive, and required relaxation, the right hon. gentleman did not think that they (the electricians) had suffered much from that Act, which he considered was probably only a blessing in disguise, as it had enabled the engineers to perfect their methods in a manner which could not have been done previously. There seems much truth in this statement, as the restrictions tended towards bringing about solid, substantial work. Continuing, Mr. Mundella expressed the opinion that we were on the eve of a great advance in the science of electric lighting, and that we might soon hope to overtake the United States, which were to some extent in advance of ourselves. He concluded by stating that the Board of Trade had no desire to hamper the progress of electricity by needless rules, and he hoped that in this, as in other branches, science would go on untrammelled by any unnecessary regulations.

An Electric Tramway in Essen.

THE General Electricity Company, of Berlin, has been commissioned to carry out the electrical portion of the Essen tramway, which in its entirety is in the hands of a large concern which has equipped many large and small tram and railways on the Continent. The length of the line is 11¾ miles. It will be arranged on the company's overhead conductor system, as put up by them at Halle, Gera, Breslau, and Stuttgart. The service will at first be commenced with twenty motor cars, which will be able to haul either one or two trailing cars up steep gradients.

Electric Cars in Paris.

SEVERAL electric tramcars on the self-contained system have been in operation in Paris for a few months on the line from La Madeleine to Saint-Denis. The cells, of which 108 are carried under the internal longitudinal seats, are of the Laurent-Cely type. Two Manchester motors are arranged under each car, and these actuate the car wheels by means of gearing. The motors take 50 ampères at 200 volts when running at 1300 revolutions, and the reduction in speed is in the ratio of 12 to 1. The maximum speed in Paris is 7½ miles an hour, and outside the fortifications the rate is 10 miles an hour. The cars carry 56 passengers, and the imperial has a covered roof, so as to afford some protection from rain. This arrangement, however, has the disadvantage of increasing the deadweight to be hauled, and this is a matter of considerable importance in secondary battery cars. The service of cars is said to give satisfaction, but nothing is known about the efficiency of the system.

New Ottoman Railways.

THE projected railway from Acre to Damascus, which has at length been finally undertaken by a German company, will be 135 miles long, and it is anticipated that upon its completion it will materially increase the volume of business between the United Kingdom and Syria. The bulk of Syria's imports is already supplied from these islands, Manchester alone disposing in the Syrian market of some £2,000,000 worth of cotton goods annually, Birmingham, Dundee, Belfast and Cardiff contributing also. On the other hand, the greater portion of Syria's exports are taken by the Continent, but, with the opening of this railway, Syria's large supply of grain and other products will be open to British markets, for these products will then be concentrated upon the Bay of Acre, which will, it is expected, enable shippers to lay them down in the British Isles at a price lower than that for similar products from America, Australia, or Russia. Eventually, perhaps, the concentration both of outward and inward traffic on the Bay of Acre will be sufficient to lead to the establishment of a direct line of steamers between the United Kingdom and Syria.

The World's Fair Exhibits.

AMONG the many exhibits interesting to engineers which will be on view at the Chicago World's Fair is a fine model of the Forth Bridge, and also a large model and relief map of the St. Gothard railway. The railways of Great Britain, and also the shipping companies and builders, are expected to send exhibits. The London and North-Western Company will send over a complete train, headed by a compound locomotive. The Great Western Railway sends its antiquated locomotive, the "Lord of the Isles." Several others will exhibit signalling systems. An interesting collection of models of battleships, cruisers, yachts, and merchant ships is also to be sent. The Philadelphia and Reading Railroad expects to exhibit the process of mining coal, with a complete anthracite coal-breaker. The Pennsylvania Railroad, in front of the special building it is erecting, will exhibit a section of a four-track railroad, including a station, with opposite waiting shed, an overhead bridge, and a complete system of points and signals, and inside the building will have an interesting historical collection showing the development of the various departments of its service. The White Star Steamship Company in its building will give an interesting steamship exhibit.

The State of the Shipbuilding Industry.

THE condition of the British shipbuilding trade has now become critical in the extreme. During the whole of the present year a gradual decline in this important branch of industry has been manifested, and the prospects for the future are discouraging in the extreme. While so many vessels are lying idle in the various ports, and freights remain as low as at present, it is futile to expect any great demand for cargo-carrying boats, and the only orders of any moment which may be anticipated are for craft for special trades. Mr. R. Knight, the secretary of the Boiler Makers' and Iron Shipbuilders' Society, presents the existing condition of affairs in a very forcible manner when he states that there are fully one-third too many men in the trade of shipbuilding for the amount of tonnage the trade requires. He contends that the great evil to everyone concerned—shipowners, shipbuilders, and workmen—is that as soon as shipping commences to make anything like a fair return to the investors, and they can afford to pay a fair price to the shipbuilder, and he in return can pay a reasonable day's wage to the workmen engaged in the industry, then, instead of allowing this state of things to continue by ordering a sufficient number of vessels to make good the losses and meet the expansion of trade, there is a superabundance of orders given out to the shipbuilder all at once, and the shipbuilder in turn rushes all the men he can get on the work, and finds fault because he cannot get more, and increases the number of apprentices. Thus there is as much shipping put into the water in twelve months as should have taken three years to build, and three times the amount of tonnage that the trade requires. The result is that the freights drop down below paying point, and then commences a cut-throat competition among shipowners and managers for freights. Few ships are built, and there is the same competition among shipbuilders for these, and workmen are discharged by thousands. There is no doubt a large amount of truth in Mr. Knight's remarks, but it is difficult to see how the condition of affairs can be altered.

Hull and District Institution of Engineers and Naval Architects.

THE second general meeting of the present session of the above institution was held on Monday evening, the 14th inst., at the society's rooms, Bond-street.

After the usual business had been transacted, Mr. H. F. Fourney, M.I.M.E., read a very useful and interesting paper on "The Metric System of Measurement and its Application."

At the outset he gave a short history of the metric system, which was originated by the French Government about 1790, and received legal sanction in 1801.

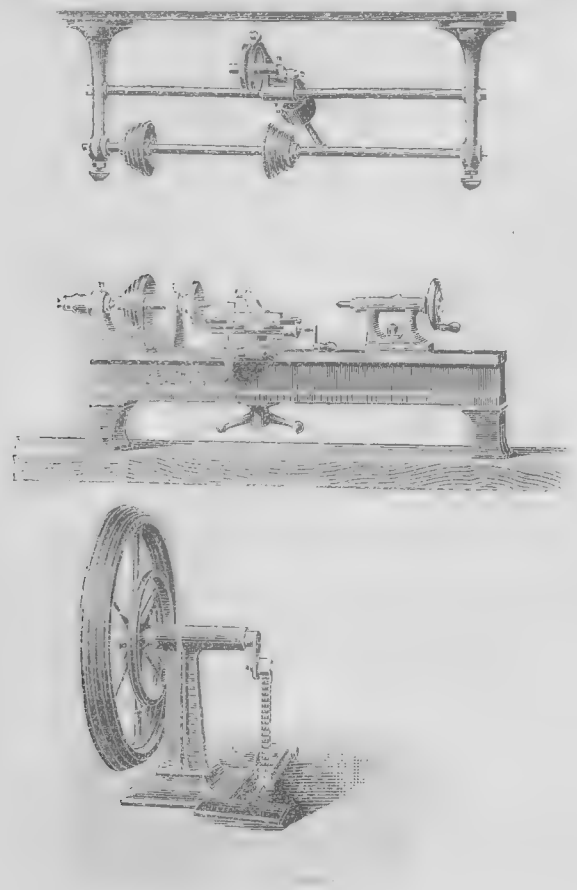
The commission appointed by France to choose a standard finally decided that $\frac{1}{10,000,000}$ of a quadrant of the meridian (the distance from the Equator to the Pole, measured as along still water) be taken as the basis of the new system, and be called a .metre. The meridian was measured between Dunkerque and Barcelona by a committee of twenty gentlemen, appointed from France, Holland, Savoy, Denmark, Spain, Tuscany, and the Roman, Asalpine, Ligurian, and Helvetian Republics, and the metre found to be 39·3,707,904 English inches. The system has now been an established fact for over 90 years, and has gradually been adopted, and is now used by 420 millions of people in different parts of the globe.

The lecturer, in stating his reason for thinking that it was of the greatest importance that England should cast away the cumbersome method of weights and measures now in vogue, and adopt the metric system, stated, amongst other things, that we should then, by offering an article acceptable and understood by the foreigner from a quantitative point of view, be meeting him to a certain extent on his own ground, and so undermine part of his competition. Proceeding, he enumerated the various tables used in the system, and pointed out the simplicity of calculations in same, his examples including measurement of piston rods and bar iron, stress on beams, water delivery of pumps, horse-power, safety-valve areas, etc. The practical difficulties in the way of its general adoption were detailed, and hints given for overcoming them. Mr. Fourney thought that the introduction of the system was only a question of time. The Government have made a first move by inserting in the educational code that scholars in the higher standards should be taught the principles of the system and its advantages. All the Chambers of Commerce throughout the country are in favour of the proposed change, as well as many chemists, engineers, opticians, all electricians, the Board of Trade, etc., etc. In conclusion, he invited all those who were anxious to push forward the change to become members of the "New Decimal Association," which is established to promote the adoption of a decimal system of weights, measures, and coinage in the United Kingdom.

The following gentlemen took part in the discussion which followed:—Messrs. C. L. Hett, J. Jamieson, C. F. Amos, J. Spear, A. H. Tyacke, A. P. Coster, T. Thompson, J. Innes, and J. H. Leetham; at the close of which a very hearty and unanimous vote of thanks was accorded to Mr. Fourney for his paper.

4in. Bench Lathes.

Of the illustrations herewith, Fig. 1 shows a neat form of bench lathe fitted complete with treadle, etc., and made by Messrs. G. Birch and Co., Islington Tool Works, Salford, Manchester. It has a bed mounted upon short stiff legs. It is fitted with a hardened steel mandrel running in a

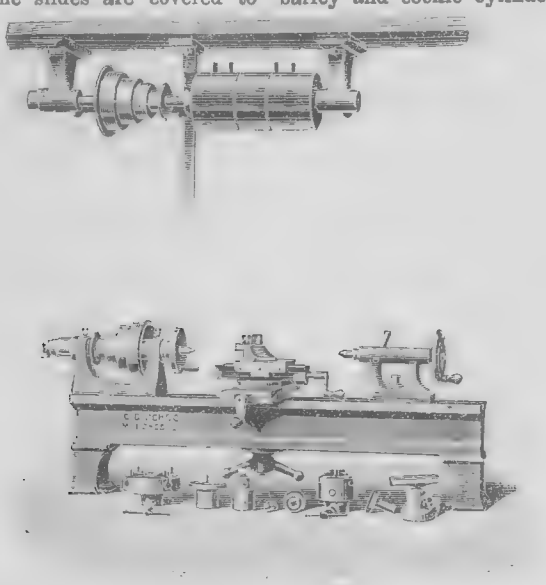


4in. Bench Lathes.—Fig. 1.

hardened steel conical bush at the front, and with an adjustable parallel bearing at the back. It is also furnished with a special tailpin arrangement, the pin being covered with an iron cup which contains a supply of oil. When the lathe is running the oil is thrown upon the inner surface of the cup and runs down again, oiling the tailpin every time the lathe is stopped. By this means, scattering of the oil is prevented, and efficient lubrication is provided at a small cost.

The cone pulley has four grooves for a gut driving band. The compound slide rest, which is arranged for both plain and taper turning, has a base fully graduated by machine for setting at any angle; the screws of the slides are covered to protect them from dirt and turnings. The self-contained treadle motion has a four-speed fly-wheel, and also an additional speed for slow motion. It is provided with long bearings, and has a chain connection with an adjustable throw to the crank. The overhead driving apparatus for driving cutters, etc., consists of two hangers with a light shaft running in swivel bearings. It is also provided with a cone pulley and traversing gallows pulleys. The pulleys on the swinging arm can be locked in any position on the stay bar; a balance weight to the tension cord is also provided.

In Fig. 2 is shown a 4in. bench lathe arranged for power driving. The bed, headstocks, and slide rest are similar to those of the 4in. treadle lathe, but the cone pulley has four speeds for a 1in. belt. Overhead driving apparatus is provided, consisting of a countershaft, fast and loose pulleys, hangers with long swivel bearings, belt shifter, etc. These lathes are completely equipped with centres, driver chuck, faceplate, hand rests, screw keys, etc. Messrs. Birch's reputation as makers of this class of machinery is so well known as to require no comments from us. Suffice it to say that these tools are in every way brought up to date, and cannot fail to be of great service either in the engineer's workshop or the amateur's laboratory.



4in. Bench Lathes.—Fig. 2.

The Design and Erection of Flour Mills on the Roller System.—XVIII.

WHEAT CLEANING—(*Continued*).

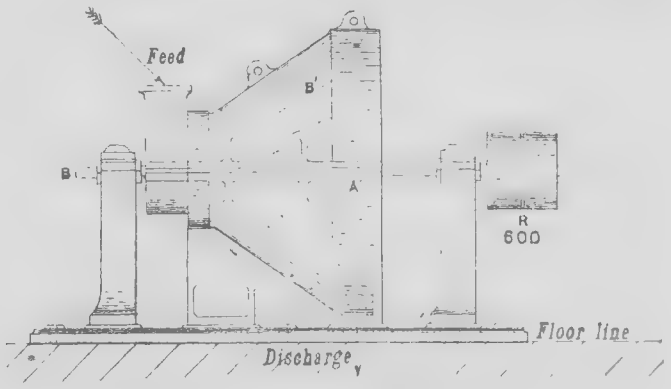
The wheat, if moderately clean, after leaving the aspirator passes through the barley and cockle cylinders; but at this stage several kinds of wheat require washing to remove the sand or fine dust adhering to the grain, also stones and dried mud balls just about the same size as a grain of wheat. Such wheats as Egyptian, Indian and Russian require washing to remove the mud, stones, etc. It does not follow that all the wheat that comes from Egypt, India or Russia, or even Chili, requires to be washed, but what is referred to more especially is the cheap wheats from the above-named places. These wheats are only used in small percentages, mixed with strong wheats.

It is usual to stone, wash and dry the large and small wheats together, so that a division at this point is only carried out at mills of large capacity, where there are two or four washing machines for the large and small wheats. Wheat-washing and stone-extracting machines that do their work with anything like a proper separation are the exception to the general rule. The washing of the wheat, however, does not present much difficulty to the designer; the difficulty arises when the wheat must be washed, and the stones and mud balls extracted at the same time, so as to make the machine automatic, and with only one discharge for washed wheat, and another for the stones and mud. The separation of the stones, etc., from the wheat is effected by means of gravity, somewhat on the lines of the old-fashioned worm-box formerly used to separate iron and other metallic substances from the wheat before it was sent to the millstones. The action of the latest wheat-stoning and washing machine is as follows:—A paddle conveyor descends with its lower end in a tank of water (the inclination of the conveyor can be varied as the circumstances of the case demand). This conveyor has a perforated false bottom, and running along the top of the conveyor is a small water-supply pipe, with a number of taps, so that the supply of water to wash the wheat can be regulated to a nicety. The wheat is fed into the tank end of the paddle conveyor, and of course passes through the water in a second or so, and the stones and other heavy bodies sink into the stone-collecting box. The wheat is now carried forward by the paddle conveyor, and after allowing the dirty water to drain away, sprays of clean cold water play on the wheat. This water is drained away through the perforated false bottom, and the washed wheat is delivered at the end of the conveyor to another machine—the dryer, or, as it is commonly called, the "whizzer." The paddle worm wheat-washing arrangement in the above machine is a distinct advance in this particular stage of wheat cleaning; for in the old design of wheat washers the wheat was washed over and over again in the same dirty water, and the result was that the wheat was very indifferently cleaned. This is impossible under the new arrangement, for reasons stated above.

There is still a deal of room for improvement in wheat-washing machinery and the stoning arrangement, for the machine appears out of all proportion to the work it has to do. A few dimensions will make this clear. A wheat-washing and stoning machine of 100 bushels per hour capacity requires a space of 22ft. by 6ft. by 9ft. head room, and to this we may add another 6ft. for a dryer, so that we require at least 170 sq. ft. of the mill floor for this one machine. Now, floor space is a valuable item to the miller, large or small; and no doubt this has as much to do with the success of a machine as anything else. The reader will understand, from what has been written, how the process of wheat washing and stoning is carried out, and we will pass on to the next machine—viz., the centrifugal conical dryer, or, in milling phraseology, the "whizzer."

The whizzer (see sketch Fig. 21) is a quickly-revolving machine of a conical shape, covered with perforated metal to allow the moisture to drain away from the wheat. In addition to the centrifugal force of the machine, as a drainer, some makers apply from 40lb. to 50lb. of steam pressure against the inside of the drainer, so that in a few hours the wheat is ready for reduction. The use of steam pressure in the whizzer is falling out of use, and another machine substituted for the purpose, after the wheat has left the whizzer—viz., an automatic dryer. The whizzer and the wheat-washing and stoning machines generally go together, as it is usual for the paddle conveyor of the washer to deliver the washed wheat direct into the whizzer. The wheat, after leaving the whizzer, is drawn off into sacks by means of an elevator and conveyor and allowed to "sweat." We will now consider the whizzer in detail. Referring to Fig. 21, it will be seen that the frame or outside covering is of cast iron, and is made in two halves. Some makers cast the shell, as it is called, in one casting, with parting plates at the joints marked A. This is a difficult job for the moulder, and it is a far more difficult job for the man who has to part the top and bottom, as, owing to the strains, it is not an uncommon occurrence for the casting to crack and fall asunder, consequently the casting becomes a waster. To guard against this loss it is advisable to have the casting as near as possible of one thickness of metal, and again the metal should be of a lively nature, and by no means sluggish. Thus No. 1 Scotch pig iron will give fluidity to inferior brands, and a little cold-blast iron will give additional strength.

The conical cylinder is covered with No. 7 gauge brass knit wire, which makes a lasting cover; all that is required from this covering is to allow the water and moisture to drain away from the wheat. One of the most important points in a whizzer is the balancing of the conical cylinder or drainer. This cylinder is run at a high speed, usually from 500 to 600 revolutions per minute, consequently great care should be exercised to obtain a true running balance. The bearings, of which there should not be less than two, should be a scraped fit, brass to brass—not $\frac{3}{32}$in. of timber packing in the brass joints, so that by a little extra turn on the cap pedestal bolts it is possible either to fire the bearing or throw the belt off. The brasses should be a scraped fit, and the cap pedestal bolts and lock nuts properly tightened down, so that there is no shake in the whizzer shaft either longitudinally or vertically. Under such conditions the whizzer cylinder ought to be moved easily by hand. If the whizzer can be made to revolve easily by hand it may be taken for granted that it is well fitted up. The foundation for a centrifugal dryer or whizzer is another important subject. By referring to Fig. 21 it will be seen that the iron



Design and Erection of Flour Mills.—Fig. 21.

casing or shell of the whizzer, and also the three bearings, are bolted to an iron foundation plate. This foundation plate is held in one position by bolts passing through the stone foundations. The reason for this is obvious. The bearings are always in line with each other, and independent of any settlement of the foundation. As a rule, wheat-washing machines and centrifugal dryers are fixed on the ground floor of the mill; but sometimes we find them on the fifth or sixth floor. In this case the centrifugal dryer must be bolted to strong beams built in the walls, as the circumstances permit, or to cross beams bolted to the main beams of the building. Under such circumstances, the beams should be fixed so as to have no movement. This should be carefully seen to, especially on the top floors of warehouses and flour mills.

There is another form of centrifugal dryer—viz., the vertical whizzer,—the only difference being that the shaft and cylinder marked B, B¹, Fig. 21, are vertical instead of being horizontal. The machine is exactly the same in every other respect, and nothing further need be said in reference to it, except that the vertical type is rapidly giving place to the horizontal machine.

(*To be continued.*)

The first-class cruiser "Royal Arthur," which was launched at Portsmouth in February last year, and which has since been engined by Messrs. Maudslay and Co., got under way on the 17th inst., for an eight hours' trial of her engines, with natural draught. The mean steam in the boiler was 146·6lb., the revolutions 100 per minute, and the vacuum 27in. The average power developed by the starboard engine was 5029, and by the port engine 5033, making a total collective power of 10,062 horses, with 0·44in. of air pressure. This was slightly in excess of the contract power, but the speed, which, as taken by log, amounted to 18·22 knots, was somewhat less than had been anticipated. The trial was considered satisfactory.

Sugar-making Machinery.

XXIII.

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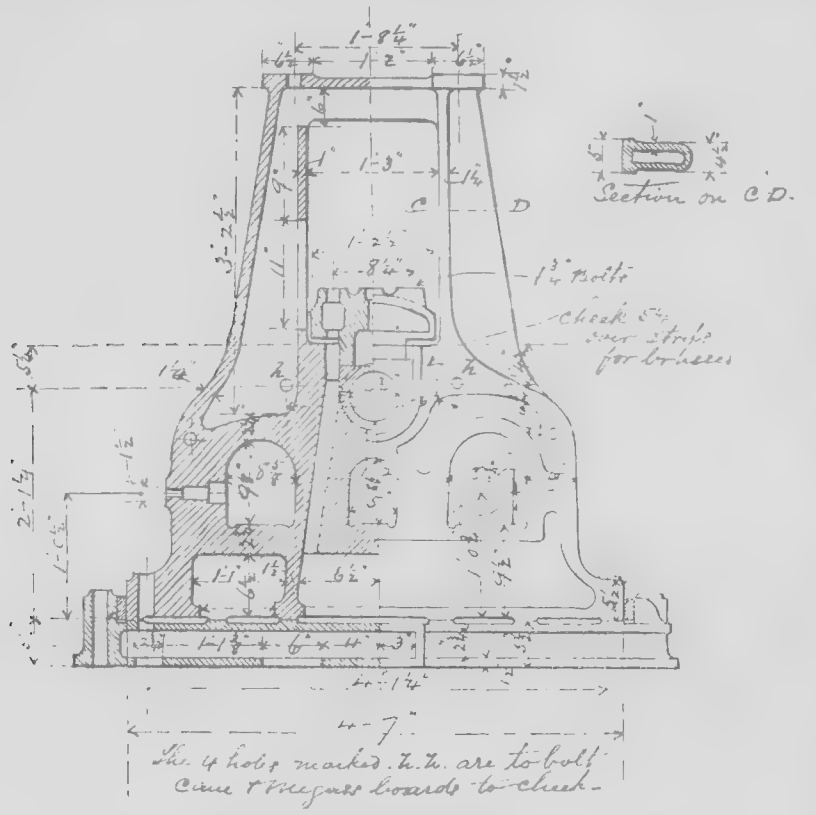
Headstocks.—The roller gudgeons run in gun-metal bearings fitted into the cheeks or headstocks, the latter having to be made very strong so as to resist the enormous stresses which come upon them in regular work. They are generally of cast iron, although wrought-iron headstocks have been made, but the expense involved has prevented their adoption to any extent. By the introduction of through bolts to take the principal stresses and a proper distribution of the material, cast-iron headstocks can be made to withstand all reasonable stresses. The style of headstock is a matter of taste, but the general appearance of mills by different makers is much alike, little points of ornamentation and shape of minor parts being the only evidence of contrast.

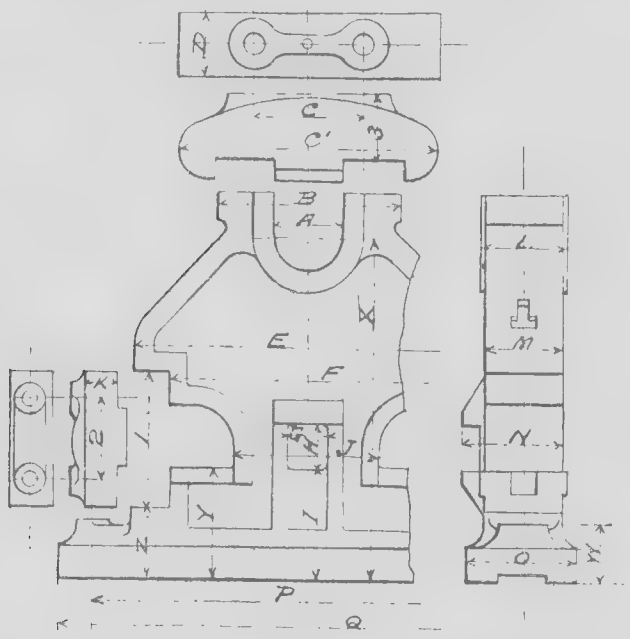
Until recently nearly all mills were made with headstocks of the "close" type. In the best class of mills of moderate size—say from 14in. rollers and upwards—the open-ended headstock is employed.



SUGAR-MAKING MACHINERY.—FIG. 46.

For cattle mills the close-ended headstock is mostly used, as it offers certain constructional advantages. In the close-ended type of headstock the setting up of the lower rolls is effected by means of set screws passing through the end of headstock, into which is inserted a square nut, the point of the screw pressing against a steel plate let into the back of the roller bearing. Fig. 46 shows a headstock of this description for a cattle mill, having rollers 16in. diameter by 24in. long. From the top of the headstock is carried up two pillars of flat oval section to support the entablature which carries the vertical driving shaft. The top cover is fastened by T-headed bolts let into the "cheeks." The figure shows the general construction of the headstock and gives the main dimensions.

Fig. 47 shows a modern type of open-ended headstock as used for the larger-sized power-driven mills. The metal of the headstock is not continuous round the bearings, as in Fig. 46, but the end is made open, the opening being closed up by the side covers, which are secured by means of T-headed bolts let into the headstocks. But sometimes through bolts are employed, passing right through and fixing both covers; by this means the stress is taken up by the bolts, relieving the headstock of all stress. The top roller cover bolts pass right down through the headstock and bedplate and through the timber beam on which the bedplate rests, and are secured by cotters and cast-iron washer plates. Table XVI. gives the leading dimensions of such headstock for the more usual sizes of mills made, also the leading dimensions for the bedplates for such mills, etc., shown in Fig. 48.



SUGAR-MAKING MACHINERY.—FIG. 47.

The dimensions of the top roller bolts may be calculated by assuming a load of 1500lb. per sq. in. on the bearings. In large mills these bolts are very often made of mild steel. The screwed end is made larger in diameter than the body of the bolt, and so also is the end through which the cotter passes, so that the sectional area at the bottom of the thread and through the cotter hole may not be less than the body of the bolt. By this means the strain is uniform throughout the bolt under the stress.

As an example, suppose a mill having rollers 34in. diameter by 78in. long; the journals would be 16in. diameter by 18in. long. At 1500lb. per square inch of projected area of bearing we have $16 \times 18 \times 1500 = 372{,}000$lb., which is resisted by two bolts $5\frac{1}{4}$in. diameter over the screw. The net sectional area of each bolt will be about 17·72in. The load per square inch on each bolt will therefore be

$$\frac{372{,}000}{35{\cdot}44} = 10{,}500\text{lb.}$$

And assuming the tensile strength of mild steel at 30 tons per square inch, the bolts will have a factor of safety of

$$\frac{2240 \times 30}{10{,}500} = \frac{67{,}200}{10{,}500} \quad 6{\cdot}4,$$

or slightly over 6.

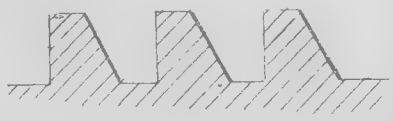
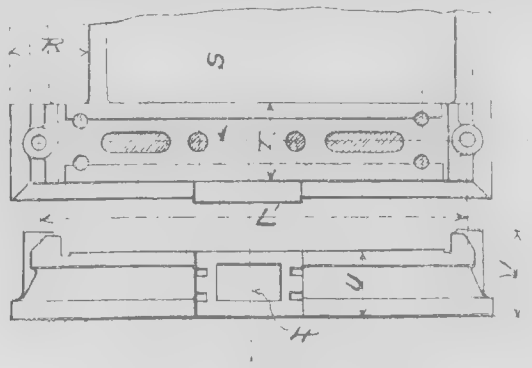


FIG. 49.

This will be found sufficient under ordinary conditions, as it is seldom a pressure of 1500lb. per sq. in. will come on the rollers. For large bolts it is good practice to cut the thread "buttress" shape, as in Fig. 49, this being a better form of thread where the load always acts in one direction: it is used for the breech screws of large guns. Take as a further example the case of a mill having rollers 30in. diameter by 60in. long. The top roller bearings will be 12in. diameter by 14in. long; and the top cover bolts will be $4\frac{1}{2}$in. diameter in the screwed part. We have then load on bearing $12 \times 14 \times 1500 = 252{,}000$lb. The net sectional area of the two bolts will be 25·8 sq. in. The load per square inch on the bolts is therefore $\frac{252{,}000}{25{\cdot}8} = 9767$lb., giving a rather higher factor of safety than in the previous example.

(To be continued.)

THE total number of freight cars in use on the various railways in the United States is about 1,200,000, and from 120,000 to 140,000 new cars are annually required to replace old and unserviceable ones, the average life of a freight car being from eight to ten years



SUGAR-MAKING MACHINERY.—FIG. 48.

TABLE XVI.—DIMENSIONS FOR SUGAR-MILL CHEEKS AND BEDPLATES.

(FIGS. 47 AND 48.)

Diameter and Length of Rollers in Inches—	20×36	22×42	24×48	26×54	28×60	30×54	30×66	32×66	32×72	36×72	36×84
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
A	8	9½	10	12	13	14⅛	14⅛	15⅝	15⅞	17¼	17¼
B	23	24	25½	29½	31½	33⅜	33⅜	—	39	—	—
C	12½	14½	15	17	18	18⅞	19½	22¾	23	24	24
C'	31½	34	36	41	45	46	50	54½	55	57½	57½
D	7	8	9	11	12	12½	13	13¾	14	—	—
E	38	45½	47⅛	54	58	60⅛	61	72	73	75	75
F	32	38	40	43	50	52	52	59	60	62	62
G	3	3½	4	4½	5	—	5	—	5	—	—
H	4½	5	5	5½	6	—	6	—	6	—	—
I	15½	17	18	19½	21	—	23	—	26½	—	—
J	16	18½	19	22	24	—	24	—	27½	—	—
K	4½	4⅝	5	5½	5½	6	6	7	7	8	8
L	7	8½	9½	11	12	12⅝	13	13⅜	14½	15¾	16
L'	62½	69½	69½	76	82½	93	93	112	112½	113	113
M	7	8	9	11	11½	12	12	13	14	15	15½
N	8¾	10	11½	13	14	14½	14½	15½	16½	17	17
O	8¾	10	10	13½	14	15	15	16½	17	17½	17¾
P	49½	55	55	63	69	78	78½	81½	82	82	82
Q	55	62	62	70	75	84½	85	102	103	103	103
R	—	—	—	15	16	—	17	18	18	18	18
S	49	58	65	73	81	75	87	96	96	97	97
T	9½	11	11	14	14½	15½	15½	17½	18	18½	18¾
U	8⅝	9	9	11	11	11	11	13¾	14	14	14
V	11	11⅞	11½	14½	14½	14½	14½	16	17	17	17
W	5	5½	5⅝	6⅝	7	7½	7	8½	8½	9	9¼
X	31	36	37	41	44	45⅜	47	51½	52	57	57
Y	11	13½	13½	14½	15	—	15½	—	19	—	—
Z	7	9	9	9⅛	9½	—	10	—	12	—	—
1	18	21	22	23½	26	26½	27	32	32	33	33
2	12	14½	14½	17	18½	18⅜	19	22	22	23	23
3	7½	9	10	11	11½	11½	12	15½	15½	15⅞	15⅞
4	6½×5½	7×6	7×6	10×7	10×7	12×6	12×7	14×8	14×9	14×9½	14×9½

The Institution of Civil Engineers.

(*Concluded from page* 208.)

A GREAT deal remained to be done before our harbour accommodation would be placed on a satisfactory footing. Harbours of refuge, such as those at Holyhead, Portland, Dover, and Alderney, were chiefly useful to shelter small sailing ships engaged in the coasting trade, detained by contrary winds. Steamers were now largely replacing the small coasters, and, being independent of wind as a motive power, did not seek shelter unless driven by undue stress of weather. The number of vessels entering Holyhead for refuge had declined from a yearly average of 3000 during the decade ending 1870 to 2500 from 1870 to 1880, and 2000 from 1880 to 1890. The true solution of the question now, apart from that of national harbours, was to distribute harbours as much as possible along the coast, and to provide such a depth of water that the usual coasting vessels might enter at all times. Government might encourage the construction and improvement of smaller harbours by loans at the lowest rate of interest, stipulating that they should be maintained at a minimum prescribed depth. Vessels entering for shelter, without breaking bulk, should be allowed to do so at all times on payment of a small toll only, considerably less than that for vessels using the harbour for commercial purposes. In the construction of harbours of this kind, the French had been in advance of us, especially along the coast east of Marseilles. The Report of the Royal Commission of 1886 on Irish Public Works should lead to the construction of harbours in Ireland which would be of untold benefit to that country.

Dock enterprise had recently received a check from which it had not yet recovered. Disasters had in many cases arisen from competition, from unprofitable extensions, and sometimes from unwise administration. What effect the absorption of docks by railway companies would have yet remained to be seen, but there was little doubt that if, as a general rule, docks were placed under properly constituted Trusts, there would be hope for those undertakings which had suffered and were still suffering so severely, and a prospect of dock extension in this country on judicious lines.

With reference to the question of rivers in connection with land drainage, and the prevention or mitigation of floods, no

complete schemes of improvement could be undertaken until the valuable suggestions of the Duke of Richmond's Committee in 1877 were incorporated in an Act of Parliament. One of the most important of its recommendations was that, in dealing with each river, each catchment-area should be placed under a single body of conservators, who would be responsible for maintaining the river from its source to its outfall in an efficient state. An Act of Parliament, framed on sound principles, would be a powerful incentive to the improvement for drainage purposes of our long-neglected rivers.

Turning to future engineering enterprises abroad, it was necessary that immediate action should be taken if a Euphrates Valley route to India were to be established under British control. It was quite evident, however, now that if the success of the undertaking were dependent upon any subsidy or guarantee from Turkey, the case would be hopeless. All that Turkey could do would be to grant a concession, which must be one that would concede privileges and not unduly fetter the hands of the promoters. There was a danger that the work, which should be undertaken by England as a political necessity, might be accomplished by others. In 1888 a concession had been granted by the Ottoman Government for certain railways in Asia Minor. English capitalists took the matter up, and an English firm entered into a provisional contract; but a German financial element had to be introduced, with the result that the German capitalists supplanted the British, and that the lines were now in their hands. The lines to be constructed would afford a communication from England through Europe to India, the only missing links being the English Channel and the Bosphorus. If a railway were to be made down the Euphrates Valley, or down the Tigris Valley from Constantinople, it would have to enter the valley by traversing the same country as the German line, and it would also be blocked at the other end if the German line were extended in the direction of Kurrachee. The hope, therefore, was almost gone that we, as a nation at any rate, could obtain direct railway communication, without encountering in Asia Minor and eastward lines belonging to a strong European power. It was, however, a matter of congratulation that the way was, for the present, still open, if the Euphrates Valley line were regarded as a link in the communication from a Mediterranean port on the Syrian coast to the Persian Gulf, which the late Sir W. P. Andrew and others had always considered as of primary importance. The Committee of the House of Commons, of 1872, was disposed to prefer Alexandretta as the Mediterranean port, as it possessed a fine natural harbour and was opposite Cyprus. As to the port on the Persian Gulf, it would probably be better, should the line be ultimately carried to Kurrachee, to keep on the left bank of the Euphrates and to select Core Abdullah or Bushire. By this route the saving from England to Bombay would be upwards of 700 miles, and to Kurrachee upwards of 1000 miles. The length of the Euphrates Valley line from the Mediterranean to the Persian Gulf would be about 850 miles, and the cost would average about £10,000 per mile. Sir W. P. Andrew estimated that the probable net traffic revenue would pay a dividend of 5 per cent. per annum. With reference to the necessity of the line from a strategical point of view, Lord Wolseley had said that the Suez Canal might be quickly and easily destroyed, and that it would be ridiculous for us as a nation to depend on it as a line of communication with our Eastern possessions in time of war. Again, if England succeeded in constructing a railway down the Euphrates Valley, it would become interesting to ascertain to what extent, in order further to develop the country, a water, or partly water and partly railway, communication could be established between the Mediterranean, opposite Cyprus, and the Persian Gulf, down the Euphrates or Tigris Valley, or down both. There was no doubt that the country would be benefited largely by the improvement of the navigation of both the Euphrates and the Tigris, and that a ship canal, to accommodate the largest vessels, could be constructed, at any rate, from the Persian Gulf to Babylon.

Owing to political and other circumstances, engineers who had been engaged in Central and South America had suffered greatly. The Argentine Republic, for instance, needed railways, harbours, docks and irrigation works to develop it, and if natural conditions were re-established, many years must elapse before the work of the engineer could be accomplished. The whole frontage of Buenos Ayres, a length of 3½ miles, was being covered with docks, and a channel 14 miles long, together with a branch channel 6 miles long, was being dredged to bring ships from the present anchorage into the docks. By this work it was estimated that the nation would benefit to the extent of about £750,000 a year. It was already proposed to unite all the railways having termini at Buenos Ayres in a central station on the land reclaimed from the River Plate by the dock and other resultant works.

Turning to Africa, it was expected that the services of the British engineer would be needed for some time to come. Upwards of 3,000,000 square miles (including Egypt), or about two-fifths of that vast continent, was now under British protection. The greater portion of this territory was without the sphere of civilisation, and could only be brought into it by railways, roads, harbours, river improvements, and pioneer works, by which alone could slavery be annihilated. The French had already constructed lines in their colony of Algeria, and proposed to extend the system southward to Lake Tchad, on the border of British territory, while the Germans were engaged upon a railway, some 200 miles long, from the sea coast to Mount Kilimanjaro. Such rivalry ought to stimulate the spirit of our country, and the directors of the Imperial British East Africa Company and of the British South Africa Company were alive to the necessity of action, and, in spite of checks, had been and were doing a great deal of work which would facilitate future engineering and other undertakings. The former had acquired potential rights over 750,000 square miles of territory, had already established Customs along the sea frontage, and was constructing roads, telegraphs, and various other preliminary works, but had failed in its endeavour to construct a railway. So vital was this to the preservation of the integrity of the territory that Parliament, in March last, had voted £20,000 for a survey from Mombasa to Victoria Nyanza. The distance was about 500 miles, and the cost of construction might be £3,000,000. If the Government guaranteed this, the annual interest would amount to, say, £90,000; but, as the line would penetrate important slave routes, it was believed that the reduction in the annual "slave vote" would, to some extent, cover the guarantee, apart from any revenue the railway might earn. The British South Africa Company had effected the peaceful occupation of Mashonaland, from which it had arranged to construct a line to the sea coast through Portuguese territory. Efforts were also at present being made to construct railways in the Transvaal and the Orange Free States with British capital—lines which, it was said, would be exceptionally remunerative. Mr. Cope Whitehouse had proposed to convert the Raian Basin into a storage reservoir for the improvement of the irrigation of the Egyptian delta, and the resources of Egypt were further capable of important development by the improvement of the first cataract of the Nile, a work not unlikely to be soon accomplished. These undertakings could only be realised while the country was under British control; were that removed or weakened, the material development of Egypt would be arrested, a state of things which must react prejudicially on other African territories, and in a manner on England also.

In conclusion, Mr. Hayter said that time had not permitted him to touch upon works in India or in the Colonies, or upon the future of electrical, mechanical, gas, and mining engineering, or upon that of shipbuilding. The profession was a vast one, and the Institution embraced every branch of it; it was full of vitality, and, far from being on the verge of finality, would probably develop largely within the next fifty years. A satisfactory feature of the age was the necessity more and more existing for an engineer to take up one branch only of the profession. Engineers were now more highly educated than formerly, and must be if they were to obtain success in their calling, and to compete with foreign engineers.

Electrical Transmission of Power for Cotton Mills.*

ELECTRIC MOTORS are now used for hundreds of purposes, but this paper will be confined to references to their uses in cotton mills.

Electric motors are frequently proportioned to use low-pressure currents of electricity, like those employed for direct incandescent lighting. There are many places where motors can be operated by wires from any of the direct incandescent lighting dynamos, but if the power required for the motor is more than about one-fifth that required to keep the whole number of lamps lighted, the lights will rise and fall in brilliancy, like those in an electric car when the motor stops and starts, and the lighting service is unsatisfactory and the life of the lamps diminished.

The problem is one which must be worked out in each case; sometimes, when a small motor is required for use at short intervals during the day, it might be more economical to use conductors from a large dynamo which is already installed for lighting the mill at other times. If constant service is required from the motor, then a separate generating dynamo is advisable, and it may be said that in the generality of work it is preferable to put in a generator suitable for furnishing the current to the motors. The principle holds as good in electrical apparatus as in all other machinery, that more satisfactory results are obtained when there is no attempt made to require a more varied service from any machine than it is fully adequate to furnish.

It is generally advisable to use electricity for the transmission of power at a much higher pressure than that found best suited to incandescent lamps, because there is a great saving in copper for conductors and a lesser proportion of the electricity absorbed by the resistance of the wires. The current of 500 volts pressure used for the trolley system of street car propulsion is not capable of inflicting serious injury on mankind, although frequently fatal to horses.

Before deciding to install an electric power plant for a service outside of what is already fixed by precedent, expense, delays, and disappointments may be avoided by deciding how much you are willing to experiment; and secondly, how much the party doing the work must experiment before the whole installation is in a practical operating condition.

The fact should not be lost sight of that electricity is merely a substitute for other methods of transmission of power. It has its losses at every step in the course, comparable with those of the wear and tear and friction of shafting and belting. Like those, it also costs money, requires attendance, and wears out. It does not in any detail give something for nothing, but the results in comparison with other mechanical means of the transmission of power are merely the addition of a lot of differences. Sometimes these differences are on one side of the account, and sometimes on the other. An installation of motors in one instance may be extremely economical, and in another highly expensive in comparison to ordinary methods of transmission of power.

Electric motors, like water wheels or steam engines, have their highest efficiency at a point near to their full proper load, and on either side their efficiency in the percentage of electricity converted into work is diminished. The practical operation of some motors has been improved by the use of fly-wheels. In its application for mill service, the most simple uses are those requiring a variable speed and direction, largely on account of causes outside of the electrical conditions in the construction of such motors. It is especially advantageous for elevators in storehouses or other buildings not requiring power elsewhere. A motor can be attached to any elevator machinery operated by a belt, and the elevator can be managed in the same manner as before, so that the men have nothing either to learn or to forget. The first motor used for operating an elevator in a cotton mill storehouse was placed in that service in 1882, and is in as good working condition to-day. Another use having a larger field is in its application for railways, in mill yards and buildings. The Salmon Falls Manufacturing Company have 2100ft. of track in the mill yard, and are operating a trolley system of cars to move all their cotton, supplies, cloth and coal, with two men, thereby dispensing with the services of a team and three men all of the time, and a fourth man a part of the time. The car makes an average speed of 600ft. per minute, and is always ready for service whenever the water wheel is running. Other mills use electric railroads from the cloth room to the storehouse with even greater reduction in cost of moving the load.

There are two systems of overhead trolley propulsion: the ordinary single overhead wire with the current returning through the wheels to the rails, and thence back through the earth to the dynamo, which is the simplest and the only one that has a practical system of switches in the wires overhead. This system contains a serious objection in the electric sparks constantly occurring in the contact of the wheels with the rails, and liable to ignite any combustible substance there, and therefore could not be safely used inside of mills. For inside use it is necessary to use the double overhead wire system, by which the circuit is made between the two wires without using the rails as conductors. In either case the overhead wires should be thoroughly protected by guard wires whenever there is a possibility of telephone or other wires falling upon them.

Electricity is fulfilling a most useful purpose in operating travelling cranes, and the few storehouses in mills which are provided with travelling cranes use them at such infrequent intervals that it is probable that hand power is still the cheapest method of operation; but for erecting shops and other places where constant service is required, electricity affords great advantages for working such cranes.

(To be continued.)

* Abstract of a paper by C. J. H. Woodbury, read before the New England Cotton Manufacturers' Association, Oct. 26, 1892.

Shipbuilding Notes.

On the 17th inst. the steamship "Mobile" was launched from the works of Messrs. Harland and Wolff, Belfast. Her dimensions are:—145ft. long, 49ft. broad, gross tonnage 5600.

The German Government have ordered eight new torpedo boats to be constructed. The dimensions are:—Length, 147ft.; breadth, 18½ft.; displacement, 140 tons. The engines are expected to develop 1500H.P.

On the 17th inst. there was launched from the yard of Messrs. Workman, Clark and Co., Belfast, a large steel screw steamer. Her principal dimensions are:—Length, 400ft.; breadth, 45ft.; depth, 31·3ft.; gross registered tonnage, about 4700. Triple-expansion engines will be supplied by the builders.

On the 18th inst. Messrs. Short Brothers launched, from their shipbuilding yard at Pallion, a steel screw steamer. The dimensions are:—Length, 170ft.; breadth, 36ft.; and depth moulded, 16ft. She is to be fitted with triple-expansion engines by Mr. John Dickinson, of Sunderland, having cylinders 18in., 29in., and 47in. diameter, by 33in. stroke. The boiler, of steel, is by the same maker, and will have a working pressure of 160lb.

Messrs. William Dobson and Co. launched, on the 16th inst., from their shipbuilding yard at Low Walker, a steel screw steamer. The vessel is 245ft. long, 34½ft. beam, and 25ft. deep. The engines, which are being built by the North-Eastern Marine Engineering Company Limited, Wallsend, are of the triple-expansion type, having cylinders 18in., 29in., and 47in. diameter, by 33in. stroke.

On the 12th inst. Messrs. S. M'Knight and Co., Ayr, launched from their yard a steel screw steamer. Her dimensions are:—Length B.P., 129ft.; breadth, 22ft.; depth moulded, 9ft. 9in.; and of 240 tons gross register. The engines, which are being supplied by Messrs. Muir and Houston, Glasgow, are compound surface-condensing, with cylinders 16in. and 32in. diameter by 22in. stroke. The boiler is 10ft. 6in. diameter by 9ft. 6in. long.

The steamer "Sir Richard Grenville" left the Wear on the 12th inst. for her trial trip. She has been built by Messrs. John Priestman and Co., Southwick, and is of the following dimensions:—Length B.P., 302ft; breadth extreme, 40ft. 3in.; depth moulded, 23ft. 8in. Her engines have been fitted by Messrs. William Allen and Co., Scotia Engine Works, Sunderland, and have cylinders 23in., 38in., and 62in. diameter, with a stroke of 42in. When the vessel was run over the measured mile she attained a speed of 11½ knots, which gave great satisfaction.

On the 12th inst. the new steamer "Kilsyth," built by Messrs. Wood, Skinner and Co., was taken to sea to run her trial trip. The vessel is 280ft. long by 37ft. 6in. beam by 20ft. 8in. deep, her full deadweight capacity being 3100 tons. Her engines were constructed by the North-Eastern Marine Engineering Company Limited, having cylinders of 20in., 32½in., and 54in. diameter, by 39in. stroke. Steam at 160lb. pressure is supplied from two large boilers. Several runs were made over the measured mile, showing a mean speed of 10½ knots, a result which was considered very satisfactory.

H.M. new second-class cruiser "Æolus," built at Devonport Dockyard, has just undergone her trials. The vessel left Keyham Basin on the 9th inst. for the preliminary trial in the Sound, everything working satisfactorily. The next day she was taken upon her eight hours' natural draught trial, when the following highly satisfactory results were obtained:—Steam, 150lb.; vacuum, 27⅞in.; revolutions, 131½; indicated horse-power, 7458; air pressure, 0·18. On the vessel's forced draught trial, after running for one hour it was found necessary to abandon further steaming owing to the dense fog prevailing. On the 15th inst. the trial was resumed, and the four hours' running gave a mean indicated horse-power of 9255, with steam pressure of 147½lb., vacuum 27in., revolutions 143, and air pressure from six to nine-tenths of an inch. During the whole of these trials the machinery worked without the slightest hitch, and great satisfaction was expressed by the Admiralty officials present. It will be seen from the above that the contract power of 7000 natural and 9000 forced draught has been considerably exceeded.

The Design and Construction of Stationary Engines.—XLI.

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Crankpins.—The thrust on the connecting rod is transmitted to the crankpin, and it reaches a maximum value when the crank is in the position shown in Fig. 143 p. 305, vol. xi.), and = L sec. ϕ.

The pin thus becomes subject to bending and shearing forces, and must be made of sufficient size to resist these forces safely. The maximum bending moment on the pin close to the crank is found by multiplying the greatest thrust on the connecting rod by the distance from centre of connecting rod to face of crank. If l = length from centre of connecting rod to face of crank, and R = greatest thrust on connecting rod, M = bending moment. Then $M = R \times l$.

The diameter of the pin will be found as follows, from the formula for the moment of resistance of shafts:—

$$d = \sqrt[3]{\frac{R \times l}{C}} \times 10{\cdot}2.$$

C = constant = 8000 for wrought iron and 10,000 for steel.

Example.—Determine diameter of crankpin for an engine having a cylinder 24in. diameter by 48in. stroke. Initial pressure in cylinder, 70lb. Angle $\phi = 12°$. R = L sec. $\phi = 452{\cdot}3 \times 70 \times 1{\cdot}0223 = 31{,}666$lb. Let the pin be 5½in. long, and 3in. from face of crank to centre of connecting rod. Then $M = 31{,}666 \times 3 = 94{,}998$ in lb., and

$$d = \sqrt[3]{\frac{94{,}998}{10{,}000}} \times 10{\cdot}2 = \sqrt[3]{96{\cdot}7} = 4{\cdot}57\text{in.}$$

The diameter thus found, although sufficient to resist bending, may not be sufficient to preserve a cool bearing in continuous work. It is therefore advisable to determine its size from a consideration of the safe bearing pressure allowable. Practice has shown that crankpins should not have a greater pressure on them than 1000lb. to the square inch of diametrical section. For good working, and to allow for surface cut away by channelling, it is not safe to allow more than from 500lb. to 900lb. under ordinary conditions. In the case of winding and rolling-mill engines, which are continually being reversed, pressures of 1000lb. and 1200lb. per square inch may be allowed, the reversal of motion facilitating the more efficient lubrication of the bearing surfaces. Taking our previous example: The diametrical section required would be $\frac{31{,}666}{900} = 35$, and as the length was 5½in., the diameter would require to be $\frac{35}{5{\cdot}5} = 6{\cdot}2$in., considerably larger than was required to resist the bending stress. The thrust on the connecting rod has been taken at its maximum; the mean pressure on the pin in actual work would be considerably less, and in practice the pin for this engine would be made about 5½in. diameter by 6in. long.

The foregoing rules are usually sufficient for determining the size of crankpins in the majority of cases. It is, however, necessary, in important cases, where every care to ensure success is desirable, to take into account the mean pressure on the pin, and the surface velocity, as these two factors determine the heat developed by friction, for which sufficient allowance must be made so that the heat may escape freely. In engines with very early cut-off, the initial pressure should be taken into account, as the area would not be sufficient if calculated for mean pressure only, the lubricant being liable to be pressed out. As before, let d = diameter of pin and l = length in inches, N = number of revolutions per minute, P = maximum total pressure (neglecting angularity of connecting rod), and M = mean total pressure on pin in lb. Since the velocity of sliding = $N \times \pi \times d$ per minute, and the heat developed will be proportional to $M \times N \times \pi \times d$, then (from the first consideration—that of mean pressure) the area of the surface of the pin $\pi\ d\ l$ must be $= M \times N \times \pi \times d$, or if C_1 = a constant

$$l = \frac{M \times N}{C_1} \quad \ldots\ldots\ldots\ldots\ (1)$$

Again, for maximum pressure, the area $d \times l$ ought to be proportional to P, or if C_2 = another constant

$$d \times l = \frac{P}{C_2} \quad \ldots\ldots\ldots\ldots\ (2)$$

C_2 may be taken at from 600 to 800 for iron and 900 to 1200 for steel.

From considerations of strength we may write

$$d = \sqrt[3]{\frac{P \times \frac{l}{2}}{600 \text{ to } 800}} \text{ for iron;}$$

and

$$d = \sqrt[3]{\frac{P \times \frac{l}{2}}{900 \text{ to } 1200}} \text{ for steel.} \quad \ldots\ldots(3)$$

In order to combine (1) and (2) it will be sufficient to make

$$l = \frac{\frac{P}{2} + M}{\frac{\frac{2}{N}}{C_1}} \quad \ldots\ldots\ldots\ldots\ (4)$$

C_1 = 110,000 to 120,000.

Example.—What size of iron crankpin will be required for a condensing engine having a cylinder 21in. diameter by 4ft. stroke, making 60 revolutions per minute, cut-off ⅓ of stroke, boiler pressure 75lb.? Assume a loss of pressure between boiler and engine of 3lb., and a total back pressure of 5lb. The area of cylinder = 346 square inches. Then the initial total pressure $P = (75 - 3 + 15 - 5) \times 346 = 28{,}372$lb. Mean total pressure (expansion coefficient being = 0·385) = $[(75 - 3 + 15) \times 0{\cdot}385 - 5] \times 346 = 9857$lb.

$$\text{Then } l = \frac{14{,}186 + 9857}{2} \times \frac{60}{110{,}000} = 6\tfrac{1}{2}\text{in.}$$

$$d = \sqrt[3]{\frac{28{,}372 \times 3\frac{1}{4}}{700}} = 5\text{in. fully.}$$

The pin, therefore, would require to be 5in. dia. by 6½in. long. Suppose the engine were non-condensing, with cut-off at ⅓ stroke; then, as before, assume a loss of 3lb. between boiler and engine, and back pressure of 18lb., expansion coefficient = 0·846.

Then M = mean total = $(75 - 3 + 15 - 18)$ $0{\cdot}846 \times 346 = 20{,}197$lb. Initial total pressure = $(75 - 3 + 15 - 18)$ $346 = 23{,}874$lb.

$$\text{Then } l = \frac{11{,}937 + 20{,}197}{2} \times \frac{60}{110{,}000} = 8{\cdot}6\text{in.;}$$

$$\text{and } d = \sqrt[3]{\frac{23{,}874 \times 4{\cdot}3}{700}} = 5{\cdot}14\text{, say } 5\tfrac{1}{4}\text{in.}$$

(To be continued.)

Notices of New Books.

ELEMENTARY MANUAL ON APPLIED MECHANICS. By PROFESSOR JAMIESON. London: Charles Griffin and Co. Limited.

DURING recent years there has been no dearth of elementary treatises on Applied Mechanics "specially arranged for elementary students preparing for the Science and Art Department's examination." We regret to say that, as a rule, these books are prepared with the distinct object of cramming the student with sufficient superficial knowledge to enable him to pass some certain examination, and we might here remark that pernicious practices of this kind will continue so long as examiners exhibit so strongly, year after year, their predilection for certain classes of questions. It appears to us that the only way to put an end to this wholesale cramming process is to have a plurality of examiners, and to so arrange matters that the name of the examiner for any year is not divulged. In this way, the diffusion of a sound elementary knowledge of fundamental principles would be greatly encouraged, to the lasting benefit of the student. In the work under notice we are pleased to see that the author, while keeping in view the requirements of first year's students, has wisely treated the subject in a sufficiently general style to meet the wants of young engineers and mechanics who are desirous of obtaining a knowledge of applied mechanics likely to be of immediate service to them in their profession. The book is divided into four stages, the first of which treats on forces in equilibrium and the principles of moments and of work as applied to simple machines. In the second section, hydraulics and hydraulic machines are considered; while the third division is on the laws of motion, centrifugal force, etc., and the fourth on properties and strengths of materials. The work is divided into 24 lectures, an arrangement which has its disadvantages, although of service to the teacher, while at the end of each lecture a set of questions is appended. The style adopted throughout the work exhibits a laudable desire on the part of the author to place facts in their most practical form, but it is, generally speaking, clumsy and inelegant. For example, one formula in the section on hydraulics is made to take the form of P = HAW, and the author remarks that "this formula will be easily remembered by Englishmen, for they are fond of saying HAW! HAW!" Possibly this may be considered very smart (for a Scotchman), but we certainly cannot express unbounded admiration for such witticisms in a scientific work of this kind. Considering that the author claims to have taken especial care in laying down principles, definitions, etc., it is strange that he has not confined himself to a stricter use of terms in many instances. The use of such expressions as "fast-speed" machinery cannot, we think, be too strongly tabooed. As a rule, the examples given are well selected; but in one or two cases there is room for improvement. Thus on page 98 a practical example is given of belt driving, in which the ratio of tensions is 6. This is of course quite unreasonable for ordinary leather belts and iron pulleys, the use of which is evidently implied. There is, however, not a very large amount of fault to be found with in this little manual, which we can recommend to the notice of students in engineering and mechanics.

TRIPLE AND QUADRUPLE-EXPANSION ENGINES AND BOILERS, AND THEIR MANAGEMENT. By A. RITCHIE LEASK. London: Tower Publishing Company. 5s.

THIS is a book on the management of triple-expansion engines and boilers, which contains a deal of information calculated to be of service to the marine engineer. We think, however, that a more modest and appropriate title might have been selected, particularly as the only reference to quadruple engines is contained in about three pages, and more than one-half of this is taken (with an alteration of a word or two) from THE MECHANICAL WORLD for November 22, 1890. For much of the technical information contained in the work the author acknowledges his indebtedness to the papers on "Forced Draught," read by Mr. James Howden before the Institute of Naval Architects in 1884 and 1886; to a similar paper read by Mr. A. E. Seaton before the Hull and District Institute of Engineers and Shipbuilders in 1891; to Mr. B. H. Thwaite, for the greater part of the chapter on "Liquid Fuel"; and to Professor V. B. Lewes, for most of the chapter on "Pitting and Corrosion in Boilers." A specification of a set of triple-expansion engines is appended. Although there is, as will be seen, not a very large amount of original matter in the book, the fact of several good authorities being drawn upon should render the book of great service to the working marine engineer.

THE CONSTRUCTION OF PUMP DETAILS. By PHILIP R. BJÖRLING. London: E. and F. N. Spon.

IN our review of Mr. Björling's "Practical Handbook on Direct-acting Pumping Engines," in our issue for September 14, 1889, we took occasion to comment upon the conspicuous absence of a practical treatise on pump construction in detail, and expressed a hope that the author would speedily favour us with a work of this description. The outcome of this was the preparation of the "Construction of Pump Details," the whole of which appeared in our pages during 1891. The work under notice is a reprint of this series of articles, although no mention of this fact appears in the preface. Most of our readers will be familiar with the series, so that we need not enumerate the various sections of the work. Suffice it to say that it contains a deal of really practical information which cannot fail to be of great service to all who are in any way concerned in pump construction.

MECHANICS FOR ENGINEERING STUDENTS. By A. N. SOMERSCALES. Hull: R. C. Annandale. 1s. 6d.

THIS is a handy little book for engineering students, comprising thirty elementary lessons on elementary mechanics. Most of the sections consist of a series of brief notes, a few examples showing their application, and a number of exercises bearing upon the specific subject treated on. In addition there is an introductory lesson on symbolic arithmetic, and an appendix consisting of a large number of miscellaneous papers with answers. The book would serve as a student's note-book, but the subject is not dealt with at sufficient length to enable the assistance of a teacher or a more pretentious work to be dispensed with.

LOCKWOOD'S DICTIONARY OF TERMS USED IN MECHANICAL ENGINEERING. Edited by a Foreman Patternmaker. London: Crosby Lockwood and Son. 7s. 6d.

WE are pleased to see that a second edition of this very useful dictionary of terms has been called for, and that its scope has been extended by the addition of an appendix containing some two hundred definitions. We have always found the work of very great service, and seldom consult its pages in vain. The new edition, we may add, has been revised and brought up to date, still further increasing its utility as a reference book of terms.

Trade Notes.

Messrs. Robert M'Laren and Co., Glasgow, have secured the contract for the pipes for the Govan new water mains.

Messrs. Brown, Marshalls and Co., of Birmingham, are building the cars for the Liverpool Overhead Electric Railway.

The directors of Messrs. Samuel Tyzack and Co., Monkwearmouth Ironworks, Sunderland, have declared a dividend of 6 per cent.

Messrs. Schuckert and Co., of Nuremburg, have completed an electric power plant at the Marien Coal Mines, near Menselwitz, Saxony.

Messrs. Marshall, Sons and Co., are carrying out some important extensions at their Britannia Engineering Works, Gainsborough.

Messrs. Christy Bros., electrical engineers, Colchester, are now erecting a complete plant for 200 lights, at Deptford Bridge Flour Mills, Greenwich.

The Electrical Power Storage Company, London, have received an order for accumulators for lighting seven trains on the Brighton and South Coast Railway.

Messrs. Dorman, Long and Co., Britannia Iron and Steel Works, Middlesbrough, announce a dividend of 6¼ per cent. for the year ending September 30.

Messrs. Paul and Co., engineers, Dumbarton, are to supply the fans for the two battleships building in Messrs. Palmer's shipbuilding yard, Gateshead-on-Tyne.

Mr. Robert Middleton, Sheepscar Foundry Leeds, has just completed two 120H.P. condensing engines, to the order of Messrs. Waterlow and Sons, printers, of London.

Messrs. Ramage and Ferguson Limited, Leith, have contracted to build a steel screw steam yacht, of 650 tons, for Mr. John Lysaght, of St. Vincent's Ironworks, Bristol.

Messrs. William Duff and Co., Glasgow, have secured an order to cover all the boilers and pipes of the electric light station, Waterloo-street, Glasgow, with their Pearl composition.

It is stated that the Vulcan Foundry Company, Newton-le-Willows, have obtained an order for twelve goods engines from the London, Brighton, and South Coast Railway Company.

The Round Oak Iron and Steel Works Company have received a large order for buoys, cables, anchors, etc., to be laid down as moorings at various ports on the west coast of South America.

Messrs. Hodges and Todd, electrical engineers, London, inform us that owing to increased business they have transferred their works from 19, Kirby-street, Hatton Garden, to 82, Turnmill-street, E.C.

Messrs. Russell and Co., Greenock, have contracted to build for Messrs. Joseph L. Adams and James Macdonald, a new Greenock firm of shipowners, two sailing vessels of 1500 tons and 2700 tons carrying capacity.

Messrs. Richard Hornsby and Sons Limited, Grantham, announce a dividend on the ordinary shares of 2s. 6d. per share, making, with the interim dividend paid last June, 5s. per share for the year ending September 30.

The Ingersoll-Sergeant Drill Company (of America), London, have recently obtained orders for six large air-compressing engines, with a full complement of rock drills and appliances for each. They are for use in various mines at Johannesburg, South Africa.

The Glengarnock Iron and Steel Company have received an order for tinplate sheets for the United States, the order to be despatched by the 24th inst. It is stated that this is the first order of the kind that has come to this country since the M'Kinley tariff came into operation, and it is expected that it will be followed by others of a similar description.

Readers of "The Mechanical World" are invited to send to the publisher of "Good Health," the new weekly paper devoted to food, drink, medicine, and sanitation, for a parcel of specimen copies, which will be sent gratis and post free, for distribution among their friends at home and abroad. Address, 391, Strand, London, or New Bridge-street, Manchester.

Wheel cutter in metal only. Every description of gearing. R. CHISLAW, 43, City-road, Manchester.

Having regard to the enormous circulation of THE MECHANICAL WORLD, the Editor suggests that it is by far the best medium for the insertion of every kind of "Wanted" advertisement, and the price is only one halfpenny per word. The Editor will be glad if MECHANICAL WORLD readers will kindly bear this in mind as occasion arises.

The Cable Railway up Mount S. Salvatore, near Lugano.*

THE author states that Dr. Battaglini, of Lugano, obtained, in December, 1885, the concession of a rack railway from Lugano to the summit of S. Salvatore, and desired, two years later, that the concession should be given to him for a cable railway from Paradiso to S. Salvatore, and for a tramway from Lugano to Paradiso, with the option of using whichever of the methods he thought best. He also stated that the work would have been proceeded with if Messrs. Bucher and Durrer, of Kägiswyl, had not proposed to use a cable railway instead of a rack railway with locomotives. Dr. Battaglini finally gave up his earlier project, and obtained a concession for a tramway from Lugano to Paradiso, and a cable railway from the latter point to the summit of S. Salvatore. This concession he afterwards sold for £1600 to Messrs. Bucher and Durrer, who commenced work in July, 1888, and finished it at the end of March, 1890. The cable railway begins near Paradiso, on the shore of the lake, about 655ft. from the landing stage; it then follows the St. Gothard railway in a straight line, and crosses the Calprinothal by the Ueberbrückungen to the middle station. The upper part begins with a curve of 980ft. radius and 492ft. long, and then has a return curve of 980ft. radius, 328ft. long, and continues afterwards straight to the summit station. The total height reached is 1973ft., and the total length of both parts of the line is 5356ft. measured on the grade, and 4942ft. on the horizontal. The station of Paradiso is 920ft., the middle station 1620ft., the S. Salvatore station 2895ft., and the peak of the mountain 2981ft. above sea-level.

The grade of the line is at first 17 per cent., and reaches 38 per cent. at Pazallo, the middle station, while in the upper section it is finally 60 per cent. The lower part of the line is through a mass of loose material; the upper part is either cut in the dolomite rock, or is carried upon walls specially built. The track is single, metre gauge, and only one car runs upon each part. A fixed motor at the middle of the line drives a cable-drum, and a car on each section, the cable passing over a drum at the highest point. In this way the two cars stand side by side at the middle station, so that passengers may change. The position of the motor in the middle was considered preferable, because it allowed cheaper cuttings, thinner cable, and obviated switching and unloading during construction, while allowing better housing for the attendants. Changing of passengers at the middle station is found to be easy. If traffic should greatly increase, automatic points can be placed in the middle of each half, and the number of cars can be increased. The permanent way rests upon massive masonry, built upon horizontal ledges cut in the mountain; a string course at the top is set in cement. The lower part of the masonry is 23·4in. high. The sleepers are of unequal-sided angle-bar, and stretch across the top of the wall, which is 4·9ft. wide. Their short sides are set in cement mortar. The sides of the masonry of the upper section are coated with cement, to prevent weathering. The S. Salvatore dolomite is not good for such work, so stone, water, and sand had to be brought from a distance; a portable engine was placed at the mid-station, and the materials raised by a wire rope. The space between the car and the sides of the cuttings is 16·5in., and between it and the signal posts was 25·25in. Niches are provided at distances of 98ft. apart, for the security of the workmen, and steps are cut to facilitate ascent. The chief points worthy of note are the bridges over the Gothard railway cutting and over the Calprinothal, and five stone crossings over the Calprino and other roads. Both of the bridges are of similar construction and strength. The first has two spans 50ft. wide, and the other six spans of 51·5ft. and 58ft. wide. The author gives details as to the bridges, from which it appears that their weight, including permanent way, is 900lb. per yard. The sleepers weight 30lb. per yard, and are placed 3·35ft. apart.

In order to secure the rails against being torn out by the sudden use of the brake, every second sleeper is anchored into concrete by bolts 19·5in. long. From tests made upon the unanchored rails to prove their resistance to lifting, it was found that when the rack was loaded to 3 tons at its working point, and a vibratory motion given to it, there was neither loosening of the sleepers nor movement in the masonry.

The rails, which are 26·6ft. long, 3·5in. high, weighing 35·5lb. per yard, are fixed down by cramps and screws. The side strain upon the anchor bolts is 1101b., caused by the side pressure produced by the eccentric position of the cable. The Abt rack is almost exactly similar to that used at the Burgenstock railway. The cars have two axles and four half-open compartments, each containing eight seats of the same class. At each end of the car is a platform for the driver. The floor of the lower car is horizontal, on a grade of 28 per cent., and the upper car on one of 50 per cent. Each car weighs 4½ tons, and both are alike with the exception of the doors, which are on opposite sides, to facilitate changing.

Particulars are then given of the construction of the cars.

Both hand and automatic brakes are fitted, and the derailing of the cars is prevented by hooks, which pass under the head of the rails.

The cable has a factor of safety of 9·5, with a load of 5·3 tons; it has a diameter of 1·24in., weighs 6·9lb. per yard, and is composed of steel wire. From the lower car it runs to the power station on to the driving drum, 13ft. in diameter, then to an idle pulley 9·8ft. in diameter, back to the driving drum, and off the idle pulley up to the top of the line, and round a drum 11·4ft. in diameter.

The cable is guided by suitable rollers, with renewable wood facings.

The power for the railway is obtained from a spring near Arogna, whence the water is brought a distance of 3·1 miles by a pipe, into a small reservoir above Maroggia. The pressure pipe is 19·5in. wide, and the fall to the power house is 830ft., and will develop 700H.P. As yet only part is used by means of two Girard turbines with horizontal shafts; the larger of these, giving 250H.P., drives an alternator with its exciter, and the other, of 125H.P., drives the dynamo used for the transmission of power. The larger plant is used for lighting the town of Lugano. Suitable governors are so arranged as to control the water supply and obtain a constant speed of 750 revolutions per minute at the machines. The turbines are connected to the dynamos by flexible leather couplings.

The dynamo for the railway gives out 60H.P. at 700 revolutions per minute, developing 1800 volts and 22 ampères. From the power house at Maroggia a copper wire 0·195in. in diameter is carried a distance of 7826 yards to the sub-station. Upon the same posts is carried the lighting wire, and also telephone and lightning protector. Oil insulators, of Messrs. Johnson and Phillips' type are used. 150 volts are lost in transmission, and the output of the motors is 43H.P., giving a combined efficiency of 71·5 per cent. A portable engine of 50H.P. is kept in reserve, in case of repairs being required to the turbines. The main shaft is driven from the motor or engine by belting, and this actuates the rope-drum by spur and bevel gearing. The direction of motion is controlled by a movable friction coupling. The author then gives details as to the various instruments in use, and as to the brake-power. The speed at which the cars travel is 3ft. per second. The various signals are given by telephone, and a special wire is carried between the rails, so that the car conductor can make connection and give bell signals also.

The company has a capital of £16,000 in shares, and £8000 in mortgage debentures. The number of persons carried the first year was 33,886.

The cost of the whole work was :—

	£
Designs, etc., purchase of concession	1,600
Purchase of land	1,000
Construction of line	11,600
Permanent way	4,000
Working material and furniture	800
Management and interest on buildings	1,600
Buildings and plant	2,600
Unforeseen expenses	800
	£24,000

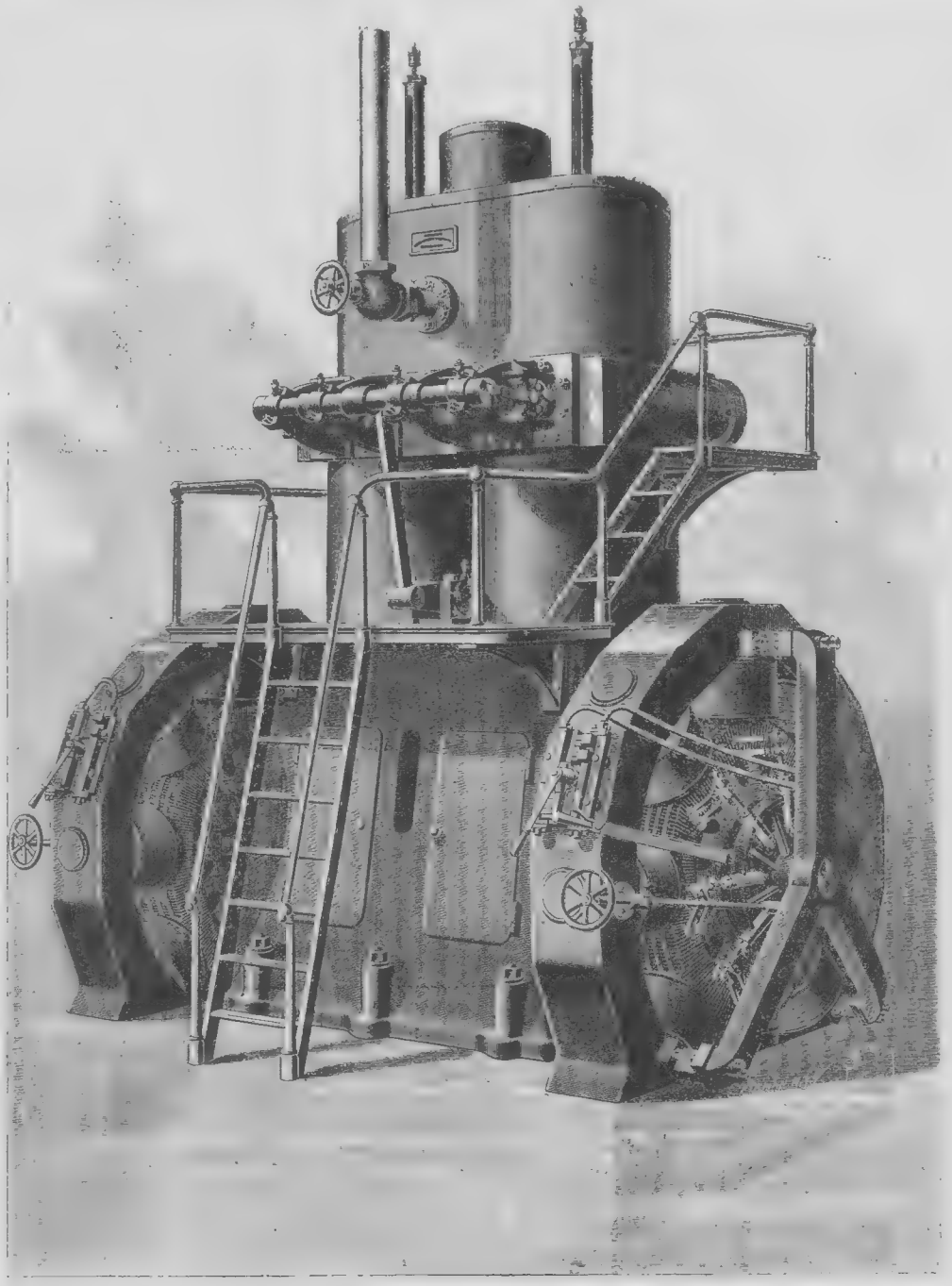
The whole journey, including the change at the middle station, takes thirty minutes, and the price of the ticket is 2s. 6d. up, 1s. 8d. down, and return ticket 3s. 4d.

* Inst. C.E. : Foreign Abstracts.

Vertical Triple-expansion Engine.

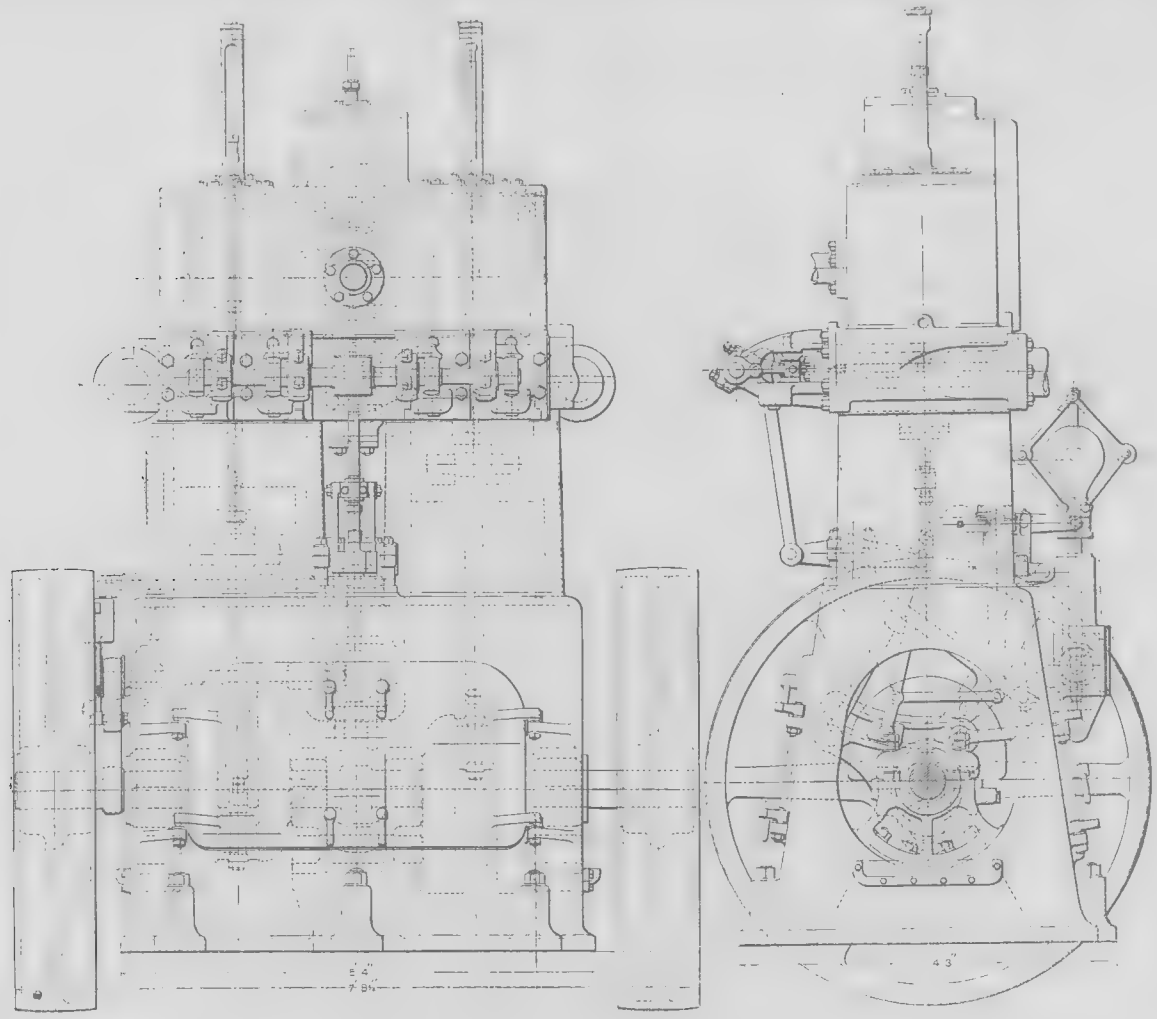
IN the accompanying illustrations is shown a new triple-expansion engine, manufactured by the Providence Steam Engine Company, Providence, R.I. The principal object of the designer has been to produce a compact motor suitable for dynamo driving and other purposes where economy of space is a desideratum, and at the same time to take advantage of the benefits of high ratios of expansion, when working either as a condensing or a non-condensing engine.

Another object sought in the design has been to make the engine self-contained, and to so arrange the reciprocating parts as to make one set of parts balance another by always moving in the opposite direction at the same time, thereby doing away with the necessity of expensive foundations, and making a quiet-running engine that can be placed in the basement of a building without fear of annoyance from jar or thumping. To meet the requirements of an engine to use steam of 180 to 200lb. pressure, piston valves are used for the high and intermediate cylinders, and grid-iron slide valves for the low-pressure cylinders. By this means frictionless valves are secured for the high and intermediate cylinders, where the pressure is high and clearance is not so important; and by the use of grid-iron valves on the low-pressure cylinders (where it is important to have the least clearance possible), with the valve seats located across the heads of the cylinders close to the piston, the clearance is reduced to the lowest limit. As these valves have a variable motion, coming nearly to a rest at the period when they are closed, and moving rapidly at the opening and closing point, they have very little wear; and as the governor only works the piston valve that controls admission to the high-pressure cylinder, which valve is perfectly balanced, the work on the governor is very light.



VERTICAL TRIPLE-EXPANSION ENGINE.

The valve gear is of the well-known Fink link type, so designed as to give a perfectly equal lap and lead, and at the same time an equal cut-off at both ends of the cylinder; and the link block is connected only to the central valve stem, which controls admission to the high-pressure cylinder. The exhaust of the high-pressure and the admission and exhaust of the intermediate, as well as the admission and exhaust of the two single-acting low-pressure cylinders, are driven from a fixed pin on the end of the link. The bearing surfaces are large, and the pins are of hardened steel working in case-hardened wrought-iron bushings, so that the wear will be slight and the parts easily replaced. The cranks are set at an angle of 180°, so that the reciprocating parts, which are of equal weight, are always moving in opposite directions, and balance one another within the frame of the engine. No vibrations are transmitted to the foundation, therefore, and a lighter foundation can be used, while the thump or pulsation that is so annoying is avoided. To prevent end oscillation due to distance between centres of cranks, each crank is counterweighted for the revolving and a portion of the reciprocating parts. The shaft is forged from solid ingot



VERTICAL TRIPLE-EXPANSION ENGINE.

open-hearth steel, and the bearings are of ample proportions. The pedestals are turned on one shaft to the same radius, and are inserted in circular seats bored in the frame. This brings them all in perfect alignment. The governor is provided with a safety stop, so arranged that should the governor belt break it will cause the link block to come to the centre of the link and slow the engine down, instead of allowing it to run away.

Running at 300 revolutions, this engine will develop 150I.H.P. We are indebted to "Power" for the illustrations and some of the foregoing particulars.

Mason College Engineering Society.

A GENERAL MEETING of the above society was held in Mason College, Birmingham, on Wednesday, the 16th inst., when a paper on "Electromotors in Factories" was read by Mr. R. H. Housman. The author divided factories into two classes—(1) Those in which power could be supplied from a single engine, as in a Lancashire cotton mill; (2) those in which the machinery, etc., requiring power was too scattered to enable one engine to economically drive the whole by means of ropes and gearing. It was in this second case that a considerable number of methods of driving might be discussed. Separate engines might be used supplied from either a battery of boilers, or each from its own; but here a loss of economy is experienced owing to condensation of steam in steam pipes, use of smaller engines, and many other causes. He then considered the degree of economy attainable when one or more large engines were employed to drive dynamos, the current being distributed by copper conductors to motors at the various places requiring power. He pointed out that at first sight a dynamo, conductor and motor seemed a rather expensive type of coupling, but it must be remembered that with this system of distribution it made very little difference whether the power were scattered or concentrated. In order to obtain a high standard of economy in this system it was necessary (1) that the generating plant be concentrated at a single centre, in order to economise labour; (2) the plant should be worked at or near its full capacity. For this latter reason it was often necessary to depart from the ideal system of one large engine and generator, and use several smaller engines and dynamos, the best number to be employed depending on the variation of load caused by the special work which has to be done in the factory. He next considered the amount of variation of load allowable in various cases; in the case of an engineer's machine shop, the ratio of maximum to minimum load might be taken as 3 to 1, but in some cases, where very sudden variations of load were experienced, as in rolling mills, the ratio might rise as high as 20 to 1. The advantages of the use of heavy fly-wheels for dealing with load variations was pointed out, but a more perfect, though less simple method, was to use a battery of secondary cells in parallel with the generating dynamo.

The next point considered was the efficiency of the motors. The author's experience gave 94, 91, and 83½ per cent. efficiency as averages for full half and quarter loads.

The author alluded to the series of experiments carried out by Mr. Peter Willans, which gave a complete key to steam-engine efficiency under varying load, and showed the disastrous effect of overloading, especially with simple non-condensing engines. Electro-motors suffered much less in efficiency when partially loaded, it being possible, with care, to obtain 70 per cent. of the steam engine I.H.P. as brake H.P. at the motor shaft, this showing about 30 per cent. in the double conversion and transmission. In the motors used for factory purposes it was necessary that the motor should run without requiring special attention, and should not spark with variation of load. The use of carbon brushes obviates this. Another difficulty encountered was the high speed at which motors were run. This, however, could be got over by using multipolar machines.

The paper was followed by a discussion, in which Messrs. [illegible] Jones, E. C. R. Marks, T. Archer, H. M. Waynforth, and Professor R. H. Smith took part, and the proceedings terminated with a vote of thanks to the author.

Practical Electrical Units.—V.

OHM'S LAW AND SPECIAL PROBLEMS.

IN the previous paper, some very elementary problems were considered for the sake of illustration. The applications of Ohm's law in electrical measurements, however, are both so numerous and varied that we shall now discuss a few questions of vital importance and some difficulty, in which the method of procedure is not so apparent. Probably the statement that "the fall of potential along a homogeneous conductor is uniform" presents some little difficulty to many students. A little consideration, however, will soon show that this statement is correct. In Fig. 5 is represented a battery of five cells, each of which, for the sake of simplicity, we will suppose has an E.M.F. of 1 volt Beginning at the zinc plate A, the E.M.F. is zero, whilst at the + plate of the first cell it is 1 volt. Adding cells in series results in a gradual rise of potential, or increases the E.M.F., as shown by figures in the sketch, until there is, in our case, a difference of potential between A and B of 5 volts. Then, since the potential of B is 5 volts above that of A, it follows that along the wire B C A there is a corresponding fall of potential, and if the cross section of the wire is uniform, the fall will be uniform from B to A. That is, if the conductor B C A be divided into five equal parts, the fall of potential along each portion is 1 volt, in the same way that the rise of potential with each cell is 1 volt. In fact, there is no reason why the fall of potential should not distribute itself so as to be proportional to the resistance of the conductor. Suppose the wire B C A be 5ft. in length, and to have a resistance of 1 ohm per foot, then, by Ohm's law, $C = \frac{E}{R}$. Therefore, $C = \frac{5 \text{ volts}}{5 \text{ ohms}} = 1$ ampère. There is then a constant current of 1 ampère flowing through the circuit, and considering the portion B C 2ft. in length of the conductor, the E.M.F. driving 1 ampère through the portion B C is given by $e = Cr$; but $r = 2$ ohms, and $C = 1$ ampère. Therefore, $e = 2 \times 1 = 2$ volts, a result which is represented by the number 3, since the fall of potential between B and C is 5 – 3 = 2 volts. In the same way the resistance of the part CA is 3 ohms, and the fall of potential is 3 volts. Therefore, in all cases the difference of potential between any two points in a conductor of uniform thickness carrying a constant current is proportional to the resistance of the wire between the two points. This may be proved algebraically in a very simple manner. Let E and R represent the E.M.F. and the resistance of the circuit B A, and e and r the E.M.F. and resistance between B and C, then by Ohm's law $\frac{E}{R} = C$ and $\frac{e}{r} = c$, but the current is constant; therefore $C = c$, and $\frac{E}{R} = \frac{e}{r}$, or $\frac{E}{e} = \frac{R}{r}$, which means that the ratio of the total E.M.F. between B and A to the E.M.F. between B and C equals the ratio of the resistance of B A to the resistance of B C. The consideration of an example

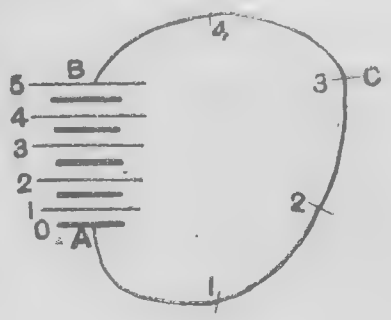


FIG. 5.

often met with in practice, and at the same time illustrating the principle of the Wheatstone Bridge, will show the importance of the above statement. Suppose two conductors are connected "in parallel," as shown in Fig. 6, one arm, A C B, having a resistance of 40 ohms and the other 30 ohms. A wire is connected at C in the first arm, so that the resistance of A C is 30 ohms; it is required to find a point D in A D B, so that no current may pass along the wire C D. In solving this problem, it is necessary to remember that if no current passes along C D, there is no difference of potential between C and D—that is, the

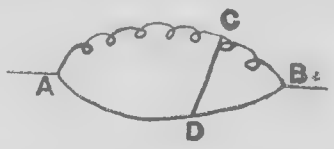


FIG. 6.

potential of C is the same as the potential of D. Now the resistance of A C is $\frac{30}{40}$ or $\frac{3}{4}$ of the resistance A C B, therefore the fall of potential between A and C is $\frac{3}{4}$ of the fall of potential between A and B; consequently the fall of potential between A and D is $\frac{3}{4}$ of the fall of potential between A and B, and therefore the resistance of A D is $\frac{3}{4}$ of the resistance of A D B, or $\frac{3}{4}$ of 30 ohms, or, what is the same thing, A D in length is $\frac{3}{4}$ of the length of A D B.

Before introducing some rather difficult problems, we will consider the following. A dynamo giving 36 ampères under a pressure of 100 volts, with a certain resistance in the circuit, is required to give only 30 ampères; what additional resistance must be added to the circuit?

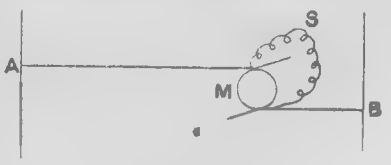


FIG. 7.

Since $R = \frac{E}{C}$ by Ohm's law, the original resistance in the circuit is $R = \frac{100 \text{ volts}}{36 \text{ ampères}} = \frac{25}{9}$ ohms. If 30 ampères are required, then $R_1 = \frac{100 \text{ volts}}{30 \text{ ampères}} = \frac{30}{9}$ ohms. Hence additional resistance $= \left(\frac{30}{9} - \frac{25}{9}\right)$ ohms $= \frac{5}{9}$ ohms. Let us now consider the following:—A motor which can safely take 5 ampères under a pressure of 50 volts without heating injuriously, is connected across the leads of a 110-volt circuit; what resistance must a shunt to the motor have if the resistance of the circuit leads is 2 ohms?

In Fig. 7, let A and B be the 110-volt leads, M the motor, and S the shunt to the

motor, the resistance of S being required.

Since $R=\frac{E}{C}$ the resistance of the motor is

$R=\frac{50\text{ volts}}{5\text{ amperes}}=10$ ohms, and if $x=$ resistance of shunt, then the combined resistance of the motor and shunt in parallel is (see previous paper):

$$R_1=\frac{1}{\frac{1}{10}+\frac{1}{x}}=\frac{10x}{10+x}\text{ ohms.}$$

Adding 2, the resistance of the leads, we get the total resistance $R=\frac{10x}{10+x}+2$. But we know that $\frac{E}{e}=\frac{R}{r}$. Therefore

$$\frac{110}{50}=\frac{2+\frac{10x}{10+x}}{\frac{10x}{10+x}}=\frac{20+12x}{10x}$$

Solving the simple equation, $\frac{11}{5}=\frac{20+12x}{10x}$ as follows, we determine the resistance of the shunt:—$11\times 10x=5\times(20+12x)$, or $110x=100+60x$, or $50x=100$; therefore, $x=2$ ohms. That is, the resistance of the shunt is 2 ohms.

It is obvious from what has already been said that the fall of potential between two points will be materially influenced by introducing additional or removing resistance in the circuit. For example, let us suppose that in a circuit with a resistance of R ohms the E.M.F. is E volts, and we wish to determine the effect on the E.M.F., E^1, between the terminals of a lamp when an additional resistance of R^1 ohms is added to the circuit. Let e be the new E.M.F. between the terminals, and r the resistance of the lamp, then by the previous rule we get, $\frac{E}{E^1}=\frac{R}{r}$ before the additional resistance R^1 is added, and $\frac{E}{e}=\frac{R+R^1}{r}$ after the additional resistance R^1 is added. Then by dividing the second equation by the first we get $\frac{E^1}{e}=\frac{R+R^1}{R}$, and by subtracting unity from each side of this equation we get $\frac{E^1}{e}-1=\frac{R+R^1}{R}-1$, or $\frac{E^1-e}{e}=\frac{R^1}{R}$. A simple numerical example will simplify this. Let the original resistance R be 10 ohms, and the additional R^1 $\frac{10}{49}$ ohms, if E^1 was 100 volts, find the drop of the potentials at the terminals of the lamp.

Substituting the values given $\frac{100-e}{e}=\frac{10}{49}$ or $\frac{100}{e}-1=\frac{1}{49}$, that is $\frac{100}{e}=\frac{1}{49}+1=\frac{1+49}{49}=\frac{50}{49}$; therefore $\frac{e}{100}=\frac{49}{50}$, and $e=\frac{49}{50}\times 100=98$ volts. Consequently the drop is 2 volts.

The result just determined is very useful expressed in terms of the additional resistance. Since $\frac{R^1}{R}=\frac{E^1-e}{e}$, then $R^1=\frac{E^1-e}{e}\times R$. Thus, in the following example, the additional resistance is determined.

Example. — What resistance must be added to lower the E.M.F. between two points from 100 volts to 95 volts when the original resistance is 19 ohms?

Since $R^1=\frac{E^1-e}{e}\times R$, and $E^1=100$, $e=95$ and $R=19$, we get $R^1=\frac{100-95}{95}\times 19=\frac{5\times 19}{95}=\frac{95}{95}=1$ ohm.

(To be continued.)

Comparisons of Cost of Electric and Forge Welding.*

INQUIRIES are constantly made as to the cost of electric welding in comparison with that of the older forge methods, and it is to this important matter that it is desirable to give special attention in this paper.

There are two important elements that enter into the cost of welding—the labour required at the welder and the necessary power to drive the dynamo

Regarding the labour, an engineer always employed in carriage and wagon factories can easily attend to the running of the dynamo. The machine is simple in its construction, it requires but very little care; it must be properly oiled, the brushes and collector rings kept clean, but beyond that needs little or no attention.

One man only is needed to operate the welder, where the pieces to be united are of regular shape, and the weight is such that they can be easily handled. In case great rapidity of work is essential, an assistant, generally a boy, will be the only additional helper required to facilitate the handling of stock.

In the case of axle work, two men are generally needed, a blacksmith to do the welding and a helper in reducing the burr or upset under hammer and in setting the axle, turning out easily 150 sets of 1in. axles, or 100 sets of 1½in. axles, as the case may be.

In case of light iron buggy tyres, one man can easily weld from 700 to 800 daily with a helper, at low wages, to bring the stock to the machine and take it away. In the case of steel tyres, 400 or 500 can be similarly welded. In heavy wagon tyres somewhat more help is needed. At the Studebaker Works two heavy tyre welders are placed side by side, with a hammer conveniently located, and a force of five men turn out a large product daily.

The smaller parts of carriage and wagon work are easily managed by a single operator. Fifth wheels, step-irons, carriage rails, dash irons, and other similar classes of work are turned out with great rapidity.

The removal of the upset or burr at the point of welding is, of course, an element of cost, and can be done in a variety of ways. Grinding was at first tried, but this was found to be too slow and expensive in connection with wagon work. Rolling was also attempted, but found to be impracticable commercially. Hammering has been found to be the cheapest and most effective method so far tried. All welds retain sufficient heat after they are removed from the welding machine to be hammered as much as may be required. Not only does the hammering reduce the burr to the size of the metal, but materially strengthens and improves the weld.

Various hammers have been designed working directly in connection with the welding machine, but with wagon and carriage work the ordinary light-power hammer is found to be the most efficient. Either power or hydraulic presses have been found to be efficient in some varieties of work.

When welding apparatus was first introduced into carriage works, the cost of preparation of the parts to be welded was quite an item of expense. It was at that time thought best to remove all forms of oxide which might have accumulated on the steel or iron, but as this required both time and labour, it was speedily abandoned and it was decided to be more economical to increase somewhat the force of the current used for the welding, even at the expense of additional power required, and no preparation of the metal is now regarded necessary, as far as the ordinary oxide formed by the rolling of metal bars is concerned.

Should there be a heavy red oxide, or serious accumulation of foreign matter, it is best to remove this before the weld is made. It is frequently done by pickling, where large quantities of metal are to be cleaned cheaply, but it is only in exceptional cases where this is necessary.

The question of actual horse-power required for welding both axles and tyres has been carefully considered, and the following figures are based upon actual experience in various works and from very careful electrical and mechanical tests made by reliable experts:—

1	inch	round	axle	requires	25	H.P. for 45sec.
1	,,	square	,,	,,	30	,, 48 ,,
1½	,,	round	,,	,,	35	,, 60 ,,
1¼	,,	square	,,	,,	40	,, 70 ,,
2	,,	round	,,	,,	75	,, 95 ,,
2	,,	square	,,	,,	90	,, 100 ,,

The slightly increased time and power required for welding the square axle is not only due to the extra metal in it, but in part to the care which it is best to use to secure a perfect alignment.

TYRE WELDING.

1	inch	× ⅜in	tyre	requires	11	H.P. for 15sec.
1¼	,,	× ⅜	,,	,,	23	,, 25 ,,
1¼	,,	× ½	,,	,,	20	,, 30 ,,
1½	,,	× ¼	,,	,,	23	,, 40 ,,
2	,,	× ½	,,	,,	29	,, 55 ,,
2	,,	× ¾	,,	,,	42	,, 62 ,,

The time above given for welding is, of course, that required for the actual application of the current only, and does not include that consumed by placing the axles or tyres in the machine, the removal of the upset and other finishing processes.

From the data thus submitted the cost of welding can be readily figured for any locality where the price of fuel and cost of labour are known.

* Abstract of a paper by F. P. Royce, read at the Buffalo Convention of the Chicago Builders' National Association.

Experiments on the Expansion of Continuous Rails.†

IN the matter of track construction to-day the question of paramount importance is that of the joint. For many years the question has been the rail. As this has received time and attention, one weak spot after another has been eliminated, and so great has been the pruning process that the one weak spot left, "the joint," is only the more glaring from the absence of many of its brothers in misfortune.

The question of a good joint is embodied in very few words—to wit, "absence of motion"; and it must be absence of motion of the cars as well as of the rails, particularly in the case of electric roads. If two rails be placed in perfect surface and alignment and closely abutted, and so held, the problem is solved. Not only must they be true to surface and line, but they must be abutted. It will not do to leave the usual expansion space.

After reviewing the evolution of the rail joint the author states:—

The joint of to-day is structurally stiff, heavy enough to take up the jar of the blow without transmitting it all to the nuts, a yielding fit that tends to counteract all motion, and large bolts, carefully located with a view to vibration. In itself good, it now stands, to a certain extent, capable of economical use, and far ahead of its brother on the steam road, even of the heaviest construction. But even so it will not do. If not, query "What then?" There is but one answer. No joint at all. While apparently a bold suggestion, it is at least worthy of thought and discussion. That the rail can be made continuous by mechanical means we know, but what of expansion and contraction? We will do without it; and that we can do so, the sequel I think will show.

To the credit of Mr. Philip Noonan, I think, belongs the first practical idea of a continuous rail. His theory, in a nutshell, may be described as gripping the rail at one end, and permitting the wave motion or flow induced by passing trains to be, so to speak, rolled out before the train wheels into a tension device that within certain limits holds what it gets. He provides against danger of rupture by a spring device which limits the strain. He put his ideas to a test, built a considerable stretch of track (some three miles) on the Lynchburg and Durham Railroad, at or near Gladys Station, Va., and it to-day is in successful use. Expert investigation and report endorse it in all essential particulars. though it is perhaps questionable whether the fastenings he used to make his rail continuous are strong and rigid enough to prohibit all yield. For details, those who care to investigate may be referred to a pamphlet on the subject, that can be obtained by addressing the inventor at the above-named place.

At a glance the problem of a street railway differs from the steam road in that the former is surrounded by the road bed, while the latter is, at least to a great extent, exposed. The effect of the surrounding road bed is twofold—

1. By its great surface friction it tends to hold the rail against change, stops all wave motion, and

2. It to some extent modifies the temperature.

The problem was to find a measure of value for both. To this end the following experiment was made:—

[The author then describes in detail an experiment in which a continuous rail was constructed and a long series of many thousands of readings of temperature taken of the air and of different parts of the road-bed and track. In drawing his conclusions he says]:—

The experiment has proved absolutely and beyond cavil that the track is restrained and held by the surface friction of the surrounding road bed. From first to last from a temperature of 22° below freezing point (or 10°) to a temperature of 89° above freezing point (or 121°), extending from March to August, there was absolutely no movement of the track out of place. Even at the ends this was true; proving that not only will the road bed hold the track as a complete structure, but that it will do it consecutively. Once bedded it will hold a rail 10ft. or 30ft., as well as one 1100ft. On this point there is no room for error. The expansion in 1100ft., if not neutralised, would equal 5¼in. under the conditions here stated, and 5¼in. would throw the rail out of line 14ft. if it were held at the ends and permitted to bow in the centre. An expansion of one rail would mean about 6in in 30ft. out of line. The query arises, "What has become of it?" It is existent, and, like all force, it would flow to the point of least resistance. In the case of a street rail, buried in the road bed, it is reasonable to believe this point is in a minute enlargement and reduction of the sectional area of the rail.

As to its effect upon the steel: Experts teach us that a variation of 7° in temperature, if held, would subject the rail to a stress of 10001b. per square inch. Taking a track laid at the low temperature of 40°, and subject to a maximum of 120°, or a variation of 80°, the stress is equal to less than 12,0001b. per square inch, much less than the elastic limit and less than the strain put upon an ordinary bridge or similar structure. It would therefore appear that the effect on the steel would be harmless. On the face of it, therefore, there is nothing to prevent us abutting our rails, and this is but the prelude to an absolutely continuous track—one without joints,—the rails welded by electricity, or otherwise connected one to the other, up to such lengths as may be deemed best.

As to its practical application, many precautions suggest themselves. It must be remembered that a track so laid will be like a huge spring under tension, absolutely safe and harmless when restrained by the road bed, but ready to spring like a shot from a cannon if, while in this condition, the road bed be removed.

One important saving that would be effected by a "track without joints" would be in the weight of the rail. A rail of 1001b. per yard is to-day in use, and next year will be extensively used. Perhaps without their knowledge, the cause of this has been the street railroad men's dearly-bought and sad experience with joints. The joint being defective, the effort has been made to secure such stability of track as to relieve the joints by means of a heavy rail. In a 1001b. rail there are but 301b. of wearing surface, of which not more than 181b. can be used before the rail will have to be thrown out; therefore there will be 821b. unused. For mere stiffness and rigidity, a 661b. rail, if supported by the proper number of crossties, will answer every engineering demand, even of electric cars at high speed. Anything over this goes to the debit of "bad joints."

† Abstract of a paper by A. J. Moxham, read at the Cleveland meeting of the American Street Railway Association.

Soldering Aluminium.

THE property of aluminium which renders soldering so difficult is very probably its easy oxidation. Although apparently resisting oxidation very strongly, yet if we take the word of those who have studied the subject closely, this resistance is not a simple process. It is believed that the instant a clean surface of aluminium is exposed to the atmosphere it is instantly covered with a film of oxide, which being continuous and unalterable protects the metal beneath it from further oxidation. The film of oxide acts effectually to prevent any other metal from coming in close enough contact with the aluminium beneath to alloy with it, and thus soldering is prevented. The use of a flux to dissolve this oxide was tried under all conditions, but none, says an American exchange, have been found practicable. In casting about for a practical solution of this problem Joseph Richards, of Philadelphia, reached the conclusion that the solder should contain its own flux, so that the instant the film of oxide was removed, the solder proper would be simultaneously present to take hold of the aluminium surface at the same instant that it was cleansed from oxide. Upon adding a percentage of phosphorus to the alloys heretofore used, far more satisfactory results were obtained. The nature of the work which could thus easily be performed with these solders led to the issuing to Mr. Richards of letters patent to the use of a deoxidising agent, such as phosphorus, in solders, and on the strength of his experimental work Mr. Richards now presents the claim that he has made a satisfactory solution of the problem of aluminium soldering.

AUTOMATIC coin-freed machines appear likely to soon supply the more immediate personal wants of the community, including those of food and drink. Several machines worked upon the principle of dropping a penny in the slot will soon be in operation, from which, in addition to the articles at present obtainable in this way, the public will be able to procure various kinds of refreshments, both solid and liquid, and, in the case of the latter, hot as well as cold. Freshly-made beverages, such as tea, coffee, and aërated waters, are also to be obtained, as well as malt and spirituous liquors. The machines can also be adapted to the supply of handkerchiefs and other small articles of dress. The main idea is to make this system of sale largely useful to the masses by supplying them with cheap but good articles of food and drink.

Metal Trade Memoranda.

During the month of October Canada exported to Great Britain 823 tons of copper ore.

The Carnegie Steel Company are building two large blast furnaces and a new converter at the Duquesne Steel Works.

The Patent Shaft and Axletree Company, Wednesbury, are expending a large amount in laying down a new mill of great dimensions for rolling Siemens steel plates up to 8ft. wide.

The Morewood Tinplate Manufacturing Company, of Elizabethport, N.J., commenced operations on the 23th ult. They will be able to turn out 5000 boxes of 20in. by 14in. tinplates per week.

The Round Oak Iron and Steel Works Company, Wolverhampton, have decided to erect new steel works. It is estimated that they will cost about £50,000. Basic Bessemer steel will be produced.

The tinplate industry is displaying more activity. The tinplate mills of the Melingriffith Company restarted a few days ago, and the Lion Works Mills at Nantyglo commenced operations on Monday evening.

The two furnaces at the new Dowlais Ironworks, Cardiff, produced respectively 1177 and 1165 tons of hematite iron during the week ending November 12. This is the largest quantity produced since the furnaces started.

The copper statistics for the first half of November, supplied by Messrs R. H. Merton and Co., state the deliveries at 6333 tons, which compares with 8990 tons for the whole of last month. Supplies, however, have also increased largely, being 4611 tons, against 6586 tons during October. The total stocks now amount to 54,356 tons, or about 1700 tons less than a fortnight ago. It remains to be seen what effect the closing of the Anaconda Mine for the next three months will produce.

Official Gazette.

Partnerships Dissolved.

H. F. JACKSON and W. L. WHITTAKER, under the style of W. L. Whittaker and Co., Queen Victoria-street, London, E.C., electrical engineers.

B. SCARF and E. HADLEY, under the style of the Bromford Iron Company, West Bromwich, iron manufacturers.

P. STRANGE and A. E. W. STANSFIELD, under the style of A. E. W. Stansfield and Co., Kingston-upon-Hull, boiler and general repairers.

WATKINSON and EARNSHAW, Huddersfield, machinists and engineers.

H. and J. SCARR, Beverley, shipbuilders, engineers, and millwrights.

A. THOMPSON and S. REDFERN, under the style of Thompson, Redfern and Co., Hollin, wood, iron and tinplate workers and engineers.

Scotch Sequestration.

J. FLETCHER AND CO., and J. FLETCHER, the only known partner, as partner and as individual, Govan, shipbuilders, November 22, at 12, Faculty Hall, Glasgow.

New Companies.

GAS POWER LOCOMOTIVE COMPANY LIMITED, —This company was registered on the 14th inst., with a capital of £20,000, divided into 5000 preference shares of £1 each, and 15,000 ordinary shares at £1 each, to acquire any patent machine or machinery, or any meter, gas engine, or other plant used in the manufacture, supply, or distribution of gas; and to carry on the business of gas makers or suppliers, civil or gas engineers, machinists or any other business or businesses which the company may think fit. The number of directors is not to be less than 3 or more than 7; qualification, £100; remuneration, £100 each per annum, and such additional sum as the company in general meeting may think fit to grant. Registered by Mr. J. Herbert Farmer, 35, Wallbrook, E.C.

LEEDS AND BRADFORD BOILER COMPANY LIMITED.—This company was registered on the 14th inst., with a capital of £10,000, divided into 40 founders' shares of £1 each and 995 ordinary shares of £10 each, to acquire the goodwill of the business of boilermakers, ironfounders, and engineers, carried on at Stanningley, in the county of York, under the style or firm of the Leeds and Bradford Boiler Company, and to acquire the real estate and the whole of the assets, and undertake the liabilities of the proprietors of that business in connection therewith, and with a view thereto to adopt and carry into effect, with or without modification, the agreement referred to in clause 3 of the company's articles of association. The number of directors is not to be less than 3, nor more than 5; qualification, £250; remuneration not stated. Registered by Messrs. Jordan and Son, 120, Chancery-lane, W.C. Registered office, Wood Nork, Stanningley, Yorks.

METAL REDUCTION COMPANY LIMITED — This company was registered on the 10th inst., with a capital of £100 000, divided into 100,000 shares of £1 each, to enter into and carry into effect with such modifications, if any, as may be agreed upon, the agreement between the Metal Reduction Syndicate Limited, of the first part, this company, of the second part, and Mr. Ernest C. Koch, of the third part, mentioned in clause 3 of the company's articles of association; to carry on the business of manufacturing, melting, refining, selling, and dealing in metals in all its branches, and any other business which is usually or can be conveniently carried on in connection with such first-mentioned businesses. The number of directors is not to be less than 3, nor more than 7; qualification, £200; remuneration, £1000, in addition to 10 per cent. of the net profits of the company after a dividend of 10 per cent. has been paid. Registered by Messrs. Ashurst and Co., 17, Throgmorton-avenue, E.C.

JAMES SAMPLE AND CO. LIMITED.—This company was registered on the 11th inst., with a capital of £2000, divided into 200 shares of £10 each, to carry on all or any of the following businesses in all their respective branches—viz., metal and brass founders, mechanical engineers, manufacturers of machinery, toolmakers, iron and brassfounders, wood-workers, smiths, painters, contractors, agents and traders, or any business of a similar character, or analogous thereto, and to fit and equip ships and floating vessels of every description. With slight modifications the regulations of Table A apply. Registered by Messrs. Sidney and Son, Blyth.

VICTORIA COPPER COMPANY LIMITED.—This company was registered on the 10th inst., with a capital of £120,000, divided into 120,000 shares of £1 each, to examine, prospect, explore, and acquire lands, mines, minerals, ores, mining rights, and claims in Western Australia, or any other part of the world, and to investigate and secure the titles thereto, and for such purposes to employ and send to any part of the world, and to pay the fees, costs, charges, and expenses of mining experts, agents, and all other persons useful, or supposed to be useful, to the attainment of such objects, and to do all such other things as are incidental or conducive to the attainment of the above objects. The number of directors is not to be less than 3, nor more than 7; the first being appointed by the subscribers to memorandum of association; qualification, £200; remuneration £100 for each director, and £50 as an additional sum for the chairman Registered by Messrs. Williams and Neville, 23, Austin Friars, E.C.

ANTI-FRICTION ROLLER BEARING SYNDICATE LIMITED.—This company was registered on the 10th inst., with a capital of £30,000, divided into 30,000 shares of £1 each, with power to divide the same into several classes, to purchase or otherwise acquire any patents, licences, concessions, and the like, conferring an exclusive or non-exclusive or limited right to use any invention which may seem to the company capable of being carried on profitably, and in particular to enter into a specified agreement for acquiring the benefit of certain inventions in the terms of the draft referred to in clause 3 of the company's articles of association, and to carry the same into effect with or without modification; to promote any other company for the purpose of acquiring all or any of the property and liabilities of this company, or for any other purpose which may seem directly or indirectly calculated to benefit the concern. The number of directors is not to be less than 3, nor more than 5; the first being named by the subscribers to the memorandum of association; qualification, £100; remuneration, £200 per annum to be divisible in such a manner as the directors themselves may from time to time determine. Registered by Messrs. Marshall and Marshall, 3 and 4, Lincoln's Inn Fields, W.C.

The Metal Market.

PRICES CURRENT.

LONDON, Nov. 21.

COPPER opened somewhat excited, with three months 5s. better than Friday's official close, at £48, following the improved inquiry from consumers on Saturday. The advance, however, received a check after a few warrants had passed, by rather free selling, three months declining to £47 17s. 6d. and £47 16s. 3d., while a small quantity of cash sold at £47 6s. 3d. Later, the offerings of cash being small and in demand, the market rallied to £47 7s. 6d., but prices again declined under realisations, cash passing at £47 6s. 3d. to £47 5s., and three months at £47 15s. to £47 13s. 9d. In the afternoon there was some fluctuation, after which the market weakened to £47 13s. 9d. three months, and £47 3s. 9d. cash, but recovered on the kerb to £47 5s. cash, and closed steadily at previous official quotations. Sales, 1300 tons. Settlement price, £47 2s. 6d. English tough, £50 10s. to £51; best selected, £51 to £52; strong sheets, £59.

TIN began with £93 15s. bid for cash, but there was nothing on the market at this price, and subsequently £93 17s. 6d. was paid both for cash in a week and three months. Holders maintained a reserved attitude in the afternoon, and with speculators covering cash moved up to £94, and then £94 2s. 6d., closing firm at 7s. 6d. advance. Sales, 50 tons. Settlement price, £94 2s. 6d. English ingots, £97.

PIG IRON started with cash buyers at 41s. 5d., and this was increased to 41s. 6d., without finding sellers, while 41s. 8d. was bid for one month. There was no change in the situation later on, holders asking 41s. 9d. for one month, and the only business to record was done privately, 42s. 0½d. being paid for 500 tons three months. The close is steady. Settlement prices:—Scotch, 41s. 6d.; Middlesbrough, 37s.; hematite, 46s. 6d.

TINPLATES are steady and unchanged. I.C. cokes, f.o.b., London, 13s.; Liverpool, 12s. 6d.; Swansea, 12s.

LEAD remains quiet, with Spanish offering at £10 3s. 9d., and £10 2s. 6d. is bid. English, £10 7s. 6d. to £10 10s.

SPELTER continues to be firmly held, £19 being wanted for virgin brands, and there are buyers at £18 17s. 6d.

ZINC SHEETS.—Silesian ordinary are unchanged at £22 2s. 6d., ex ship. Belgian are steady; V.M. brands, £22 5s., ex ship, and £22 f.o.b. Antwerp.

OFFICIAL CLOSING QUOTATIONS.

	£	s.	d.	£	s.	d.
COPPER—						
G. M. B.—Cash	47	3	9	47	11	3
" Three months	47	13	9	48	1	3
English tough	—	—	—			
Best selected	—	—	—			
Strong sheets	—	—	—			
TIN—						
Fine foreign—Cash	94	2	6	94	12	6
" " Three months	94	2	6	94	12	6
Australian—Cash	94	17	6	95	7	6

	s.	d.
PIG IRON—		
Scotch warrants—Cash	41	6
" One month	41	8
Middlesbrough—Cash	37	0
" One month	—	
Hematite—Cash	46	6
" One month	—	

GLASGOW, Nov. 21.—The pig iron market was very quiet to-day, and the tone was flat. In all some 15,000 tons Scotch were dealt in, but no small part of the business was on forfeit conditions, so that it possessed little value as a reflection of the actual state of things. Hematite was quotably dearer but neglected. The shipments of Scotch last week were 5351 tons, being an increase on the corresponding week of last year of 1482 tons, making the increase for the year 27,082 tons.

QUOTATIONS.

	Highest. s.	d.	Lowest. s.	d.
Scotch warrants—Cash	41	7	41	6
" One month	41	8½	41	7½
Middlesbrough—Cash	37	0	37	0
" One month	—		—	
Hematite—Cash	46	6	46	6
" One month	—		—	

Trade Marks.

The following is the Official List of Applications published from November 9 to November 16, for the Registration of Trade Marks, so far as relates to the Metal Trades.

CLASS 5.

MOSES EADON

159,030—2723 S. Steel. MOSES EADON AND SONS, President Works, Sheffield; steel and tool manufacturers.—26th September, 1891. Mark used by applicants and their predecessors in business for over 25 years before 13th August, 1875.

CLASS 5.

MOSS & GAMBLES

159,099—2732 S. Steel. MOSS AND GAMBLE BROS., Franklin Works, Sheffield; steel manufacturers and merchants.—6th September, 1891. Mark used by applicants and their predecessors in business for over twenty years before 13th August, 1875.

CLASS 5.

MG

159,102—2735 S. Steel. MOSS AND GAMBLE BROS., Franklin Works, Sheffield; steel manufacturers and merchants.—26th September, 1891. Mark used by applicants and their predecessors in business for over ten years before 13th August, 1875.

CLASS 5.

BENGALL

160,537—2746 S. Unwrought and partly wrought metals used in manufacture. THOMAS RADLEY CADMAN, 211, St. Mary's-road, Sheffield; manufacturer.—18th November, 1891.

CLASS 5.

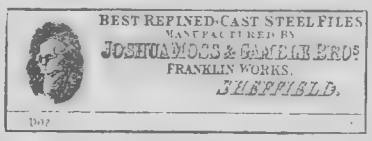
160,970—2761 S. Unwrought and partly wrought metals used in manufacture. JOHN PERIGO, 22, Rockingham-street, Sheffield; manufacturer.—2nd December, 1891.

CLASS 6.

"The essential particular of the Trade Mark is the device, and the applicants disclaim any right to the exclusive use of the added matter."

159,087—2720 S. Machinery and parts of machinery, not included in Class 7, composed wholly or partly of metal. MOSES EADON AND SONS, President Works, Sheffield; steel and tool manufacturers.—26th September, 1891.

CLASS 12.



159,098—2731 S. Files. MOSS AND GAMBLE BROS., Franklin Works, Sheffield; steel manufacturers and merchants.—26th September, 1891 Mark used by applicants and their predecessors in business for a period commencing over twenty years before 13th August, 1875. *By Consent.*

CLASS 13.

"The essential particular of the Trade Mark is the device only, and the applicants disclaim any right to the exclusive use of the words 'Racket Brand.'"

163,842. Metal goods not included in other Classes. A. MURCOTT AND CO., 1, Helena-street, Parade, Birmingham; merchants and manufacturers.—29th March, 1892.

Letters to the Editor.

*** *We do not hold ourselves responsible for opinions expressed by correspondents.*

*** *The name and address of the writer (not necessarily for publication) must in all cases accompany letters intended for insertion, or containing queries.*

*** *Letters intended for publication in the current week's issue must reach our Manchester Office not later than by the first post on the Tuesday preceding the date of publication.*

SUGAR-MAKING MACHINERY.

To the Editor of THE MECHANICAL WORLD.

SIR,—Replying to the letter of "R. Elliot" in your issue of the 4th inst., with respect to the pressure on sugar-mill rolls, I have to remind him that the statement referred to occurs in an extract from an article on "Sugar-mill Rolls," which appeared some time ago in the "Engineer," and which was evidently written by one having considerable experience of this class of work.

Pressures of 1500lb. per square inch are undoubtedly high, but your correspondent is mistaken in supposing that they represent every-day working pressures. The writer of the article referred to in the "Engineer" states that he "has in *several* instances (the italics are mine) *adopted* a load of 1500lb. per square inch of journal surface," evidently for the purpose only of calculating the size of his shafts.

In practice this load will not be reached continuously, but may come on the bearing intermittently, with more or less frequency, when hard canes are being ground, or the feeding becomes irregular.

So far as I know, there are no records anywhere of any reliable experiments of pressures on such bearings; but they have often been found *warm* during work, which fact would seem to show that the limit of 1200lb. laid down by Rankine was exceeded without any trouble being experienced.

In the case of rolling-mill engines, the pressure on the crankpins of many of them often amounts to 1200lb. per square inch of projected area. It is, of course, true in this case that the reversal of motion is favourable to more effective lubrication.

In the case of sugar-mill roller bearings, the surface speed is very slow, and (notwithstanding the dictum of most authorities that friction is independent of the velocity) I am of opinion that the *slowness* of revolution of the sugar-mill roll is an element in the satisfactory working of such journals under heavy loads. The roller pinions for a mill having rolls 34in. diameter by 78in. long would be 5in. pitch if of steel, and 5¾in. pitch if of iron, 16in. wide on the face, and be shrouded to the pitch line.

When dealing with the gearing for such mills, I shall probably work out an example showing the stress on the teeth, giving the dimensions used in practice.

THE WRITER OF THE ARTICLES.

MILL-HOIST ROPES.

To the Editor of THE MECHANICAL WORLD.

SIR,—At the inquest on the victims of the recent mill-hoist accident at Birstal, the expert witness said the accident was caused by the ropes slipping in the grooved pulleys, which were round at the bottom instead of being V-shaped.

The makers of steel ropes for hoist purposes advise the use of pulleys with round bottom grooves, and condemn the V groove as injurious to the wire rope.

Will some of your numerous readers who have experience in these matters explain this apparent discrepancy. J. C. C.

Huddersfield, Nov. 5.

THE GYROSCOPE.

To the Editor of THE MECHANICAL WORLD.

SIR,—It seems to be the habit amongst a certain class of your correspondents to propound some elementary question in mathematical physics, as though they wished for information on the subject. If any good-natured person takes the trouble to answer them they immediately declare that he is quite wrong, and seize the opportunity to air their own peculiar notions on the subject, which you, sir, with great forbearance, permit them to do. It does not seem to occur to Mr. Wilkie that the question he raised in your last issue has long been settled, and that the solutions are readily accessible to anyone who has the patience to read them and the brains to understand them. Mr. Wilkie's letter seemed to be the genuine appeal of a painstaking, if somewhat dull, student in difficulties. It shows that he understood my lecture as little as he understood his text-book; but he pounces, after the manner of his kind, on what he imagines to be a mistake of mine, when there is no mistake at all, and then proceeds to air his ignorance. No one

can understand the action of a gyroscope before getting a thorough mastery of the principle of the composition and resolution of angular velocities. If, instead of seeking a "third force," he measure the upward thrust at the support, as I pointed out, he will be on a surer way towards an understanding of the problem. Very likely Mr. Wilkie will consider this an abusive letter, and remind me that "abuse is not argument." To this I can only reply in the words of the pot-house politician: "I'm not arguing with you, I am only telling you." It is not a duty of mine to clear away the fog in which Mr. Wilkie has involved himself, since I have not the honour to be his tutor. Thanking you in anticipation for the insertion of this letter.

FRANK MORRISON.

Kirkton, Forfar, Nov. 19.

LAWS OF FRICTION—GEOMETRY.

To the Editor of THE MECHANICAL WORLD.

SIR,—On reading the article in your last issue on the "Laws of Friction," I think the writer must have overlooked the facts himself, or that he ought more fully to have explained his meaning.

I am alluding to his remarks on the extra lapping with regard to belts increasing their holding power, and a 4in. shaft having greater frictional resistance than one of 2in. diameter.

With regard to the former, although the tension on the belt might not be increased, yet when more lap is given to a belt generally the resultant pressure on the pulley is increased, and therefore the friction.

Again, with respect to the latter, the amount of friction remains the same, but in one case it acts at a radius of 2in., and in the other at a radius of 1in.

I would also like to point out that the better class of text-books do not allow the student to fall into the error that the laws of friction are *absolutely true*, they are only approximate, and do not apply with equal truth to high velocities.

Also with regard to "T. J. B.'s" reply to "Geometry's" question; it is not correct for *any* triangle, as he states. For *any* triangle, the centre of the inscribed circle is the point of intersection of the bisectors of *any* two angles; and if perpendiculars be dropped on to the three sides, each is the radius of the inscribed circle, and the foot of each perpendicular is where the circle touches that side.

From this it will be seen that "T. J. B.'s" reply is true only for an isosceles triangle, as the perpendicular from the vertex of an isosceles triangle to the base bisects both the angle and the base.

A STUDENT.

Chatham, Nov. 21.

Miscellaneous Items.

Japan is to have a cable-laying steamer for native engineers.

The Berlin Metropolitan Railway intend using the electric light in their railway carriages.

A new locomotive was tested recently on the line between Berlin and Frankfort-on-the-Main. A speed of about 58 miles an hour was attained.

A parcel of nearly 400oz. of gold from the Salisbury reefs in Mashonaland was exhibited in Capetown on the 18th inst., before being despatched to England.

The death is announced, on the 11th inst., of Mr. Samuel Barker, one of the brothers who constituted the firm of Messrs. H. and S. Barker, ironfounders, Mexborough.

The latest German railway statistics afford the materials for an interesting comparison between the railway systems of England, France, and Germany. The last-named country, with an increase in mileage of 22 per cent. during the last ten years, shows an increase also in aggregate receipts for 1890-91 of 41 per cent., as against 1881-2. France, with an increase of 33 per cent., and England with an increase of 10 per cent. in their mileage during the last decade, have increases in revenue amounting to 3 and 20 per cent. respectively.

At the ordinary meeting of the Institution of Civil Engineers, held on the 15th inst., four papers were read dealing with the construction of graving docks in the Colonies and in the United Kingdom. The first paper was on the "Halifax Graving Dock, Nova Scotia," by the Hon. R. C. Parsons, M. Inst. C.E. The second paper contained a description of the "Cockatoo Island Graving Dock, New South Wales," by Mr. Edward W Young, M. Inst. C.E. The third paper gave an account of the "Alexandra Graving Dock, Belfast," by Mr. W. R. Kelly, M. Inst. C.E. The last paper was a record of the "Construction of a Concrete Graving Dock at Newport, Mon.," by Mr. R. Pickwell, Assoc. M. Inst. C.E.

It is stated that sixty millions sterling has been engulfed in the Panama Canal enterprise.

Telephonic communication is about to be established between Berlin and Posen, a distance of nearly 170 miles.

Queries.

☞ Readers are invited to avail themselves of this section for practical information on questions relating to Mechanical Engineering and the Scientific Industries.

☞ Queries and Replies should arrive at the Manchester Office not later than by the first post on the Tuesday preceding the date of publication.

IRON MIXTURE.—Can any reader supply a mixture for steam hammer heads (chilled)?—TYRO.

CASTINGS.—Can any reader inform me how to secure clean castings which have wrought-iron pieces "cast in."?—L. U.

ECCENTRIC WHEELS.—Will any reader of THE MECHANICAL WORLD inform me how to set out a pair of eccentric wheels correctly?—J. S. P.

SPEED OF DRIVE CHAIN.—Can any reader give me any particulars as to the safe speed at which Ewart's patent chain may be run?—SECOND MOTION.

CONVERTING GAS ENGINES.—Will any reader kindly inform me how to convert a Crossley's gas engine, 15H.P., slide-valve type, to a tube firing type?—FITTER.

SWEDISH BESSEMER STEEL.—Can any reader inform me how Swedish Bessemer steel is made, and also give highest amount of carbon it contains?—FORGEMAN.

COATING FOR WATER PIPES.—Can any reader tell me how to ascertain whether cast-iron pipes have been properly coated with Dr. Smith's solution?—WATER PIPE.

MOULDING SAND.—Will any reader inform me where the fine moulding sand is obtained which is used for making small malleable-iron castings in Walsall?—IRON FOUNDER.

LOCOMOTIVE AXLE BOX.—When a locomotive is pulling a heavy train up an incline, on which side of the axle box is there the greatest pressure—after or forward?—J. M. (Mexico).

TWIST DRILL CUTTERS.—Can any reader give me a method of getting the correct thickness and shape of cutter for any diameter of twist drill, straight lip? A drawing will greatly oblige.—J. M. F.

MILLING MACHINE WHEELS.—Can any reader give me the number of wheels that should accompany a milling machine, and the number of teeth both in the smallest and largest wheels; also whether they rise by two teeth or four?—TOOLS.

PRESSED PAPER.—I shall be obliged if any reader can furnish me with names of firms in England or abroad who press paper for making trays, wheels, teeth, etc., and the widening circle of articles now made of compressed paper or pulp.—A CONSTANT READER.

TRIPLE-EXPANSION ENGINE CYLINDERS.—Will any reader show me how to find the diameters of the H.P. and M.P. cylinders, from the following data:—Ddiameter of L.P. cylinder, 8sin.; stroke, 5ft.; revolutions, 73; boiler pressure, 180lb.; 4,500I.H.P.; cut-off in H.P. cylinder, 0·6 stroke.—W. G.

HARDENING AND TEMPERING.—Can any reader inform me how to harden and temper a number of straight steel wires 13 gauge and 16in. long? I have tried several ways, but I cannot keep them straight. I may say that I have hardened them in oil, and one at a time.—BLACKSMITH.

LOSSES IN STEEL FURNACES.—Could any reader kindly inform me the average per cent. of actual loss, and the average per cent. of skull, in the charge of a Siemens open-hearth steel furnace working charges of from 30 to 40 tons? And also the percentage of loss in heating slabs and ingots in the Siemens regenerative gas furnace?—J. R. R.

WINDMILL.—I want to erect a small windmill to grind corn, cut chaff, etc., for stock on a farm, and shall be obliged if someone will advise me how to make it. What is the best kind of mill—that made on the American plan, a wheel with slats, on the principle of the venetian blind, or the old arm and sail pattern? What length of arms and sail should I require to produce 2 or 3H.P., as the case may be? Shall be glad of any information, drawings, or plans.—RUSTIC.

Replies.

☞ Owing to the constant increase in our correspondence, we regret that we have no alternative but to announce that we cannot reply by post to Queries even when stamped envelopes are sent.

☞ Queries and Replies must in all cases be accompanied by the names and addresses of the writers, as no notice will be taken of anonymous communications.

RED LICHTIE.—No address given.

Z.—We cannot reply to anonymous correspondents.

H. CARR.—Your idea appears to us to have some merit.

OVAL.—Do you mean an oval chuck, or simply a method of drawing an ellipse?

SCILUARDYH.—Write to the Secretary Durham College of Science, Newcastle-on-Tyne.

WATER METER.—Your letter does not advance matters much. See reply to "Red Lichtie."

TYRO.—Spretson's "Casting and Founding" (18s.) will suit you. It may be had from our office.

TROILUS.—Yes, they are published for sale. Write direct to Mr. Phillips, at the address given.

G. G. HARDERN.—Many thanks for your letter. We will attend to the matter as opportunity offers.

A READER.—If you mean "Water Engineering," Slagg's treatise is the best we know. Price 7s. 6d., from our office.

DYNAMO.—Yes: the valve would offer more resistance to motion, and the total actual pressure on the back of the valve would be increased.

JOHN GONNEL.—You will require to have them made specially. Messrs. G. Birch and Co., Islington Grove, Salford, would probably undertake the job

LATHE.—Messrs. G. Birch and Co., Islington Grove, Salford, or Messrs. Geo. Richards and Co. Limited, Broadheath, will supply you with full particulars upon application.

R. A. C.—(1.) Yes. (2.) No; procure a copy of Hasluck's "Model Engineer's Handybook" 2s. (3.) You cannot return your exhaust steam to the boiler advantageously.

J. T. JENKINS.—We think three years are considered sufficient, but we would advise you to write to Mr. John Lockie, 2, Custom House Chambers, Leith, who will give you full particulars.

J. L., le.—"Handbook on Pump Construction," by Björling (5s.) may suit you. See also reviews of books in this issue. There is no book dealing specially with the subjects mentioned in the latter portion of your letter.

W. AND J. DODSLEY.—(1.) Yes, we believe a code of regulations has been framed. Apply to the Secretary Marine Department, Board of Trade, Whitehall, London, S.W. (2.) Messrs. Sargeant and Co., Eel Pie Island, Chiswick, Middlesex.

PNEUMATIC RIVETING MACHINES.—Required the address of makers of pneumatic riveting machines.—W. G.——A.—Messrs. De Bergue and Co. Limited, Manchester, make these machines, working at 70lb. pressure.—WATER-METER.

Latest Inventions.

APPLICATIONS FOR LETTERS PATENT.

When Patents have been "communicated," the name of the communicating party is printed in italics.

Where complete specification accompanies application, an asterisk is suffixed.

5th November, 1892.

19,957 BALL BEARINGS. C H Sims and A J Fitch.

19,959 APPARATUS for MEASURING ELECTRICITY. E H P Humphreys and W Friese-Greene.

19,960 AMMETERS and VOLTMETERS. E H P Humphreys and W Friese-Greene.

19,961 CENTRIFUGAL PUMPS. A D Ellis and W B Crichton.

19,965 APPARATUS for LUBRICATING and for PACKING STUFFING BOXES. R Archer.

19,967 AIR PROPELLER. J E Hunter and H Haley.

19,972 VALVE or COCK DEVICE for the DISTRIBUTION of WATER. F G Paynter.

19,976 AUTOMATIC VALVE REGULATORS for HOT AIR. J H Fox.

19,981 MATERIALS and APPARATUS for FILTERING LIQUIDS. H H Lake. (*Wormser Filterplattenwerk, Peters, Bittel and Co.*, Germany.)

19,982 FILE-CUTTING MACHINES. A Ufer.

19,987 COUPLINGS for ROLLING STOCK. H H Lake. (*F A Humpidge*, Canada.)

7th November, 1892.

19,992 ELECTRIC ENERGY METER. R Pippette.

19,994 MACHINES for REELING WIRE. H E Hodgson.

20,003 ACQUISITION and TRANSMISSION of ROTARY MOTIVE POWER. A Cameron, jun.

20,011 AUTOMATIC COUPLING for RAILWAY VEHICLES.* A Hoyrmann and A Stein.

20,014 PROCESS for HARDENING CAST IRON. H Pidot and H Charlier.

20,017 WATER or LIQUID GAUGES. E Morton and G Edwards.

20,027 FILTERING MACHINERY. J M Smales.

20,029 ADJUSTABLE WRENCHES or SPANNERS.* A H Bishop.

20,037 APPARATUS for COATING METALLIC PLATES or SHEETS WITH TIN. J S Tregoning and W Evans.

20,040 INGOT IRON and STEEL. C H Ridsdale and the North-Eastern Steel Company Ltd.

20,046 STONE-DRESSING MACHINES. F Trier.

20,048 VIBRATING ENGINES. T Hawkins.

20,057 PHONOGRAPHS. E O Kumberg.

20,063 HYDRAULIC RIVETERS.* V Schönbach.

20,068 POWER APPLYING MECHANISM.* G W and M G Gillette.

8th November, 1892.

20,069 EXHAUST STEAM-PIPE HEAD. R B Rigby.

20,070 COUNTING MECHANISM. J Paton.

20,081 LOCK-UP BOX for STOP-COCKS. R T Spring.

20,085 REVOLVING STOKERS.* W Fairweather. (*N W Pratt* and *The Babcock and Wilcox Company*, United States.)

20,086 CENTRIFUGAL PUMPS and BLAST FANS. K Leverkus.

20,087 FURNACES for ANNEALING WIRE. H E Hodgson.

20,088 GAS ENGINE GOVERNOR GEAR. C M Dowie and C B Handyside.

20,099 MOTIVE POWER.* W Crook, sen.

20,100 TELEPHONE SWITCHES. W A and E A Shaw.

20,103 STEAM BOILERS.* G F Tinkham.

20,105 AUTOMATIC ADJUSTMENTS for BEARING BRASSES. W H Allen and others.

20,106 MACHINERY for FINISHING NEEDLES. H Milward and Sons Limited and J Swann.

20,113 APPARATUS for DREDGING and EXCAVATING. J Watts.

20,115 DRIVING BELT FASTENER. G Keep.

20,116 SHIFTING SPANNERS or WRENCHES. J W Hall.

20,122 WHEELS for RAISING WATER for USE as a MOTIVE POWER.* H C Gardner.

20,123 DEVICE for CLEANING TRAM LINES. G S Morris.

20,138 NUT-LOCKING DEVICES for TRAMWAYS. G Heaton.

20,141 RAILWAY SIGNALS.* J Y Johnson. (*J W Lattig* and *W F D Pascoe*, United States.)

20,155 EXPLOSION ENGINES. G V Sheffield.

9th November, 1892.

20,159 FORCE PUMP to WORK by MEANS of the WAVES. C Barnett.

20,164 COUPLING or UNCOUPLING CYLINDERS and DRUMS. A Ainley.

20,168 RAILWAY SIGNALS. T Gare.

20,170 STEAM HAMMERS. R Spencer.

20,171 ENGINE PACKINGS.* H G Small and G W Parkes.

20,189 PROCESS for AUGMENTING the RESISTANCE of IRON, STEEL, ETC. F Feldhaus and J Ollaguier.

20,194 SCREW PROPELLERS. J Stephens.

20,208 SOLDER for ALUMINIUM.* W A Briggs. (*J W Richards*, United States.)

20,210 SWITCH for MEAT RAILS and OTHER RAILWAYS.* W H Beck. (*A L McCredie*, New South Wales.

20,214 ELECTROLYTICAL APPARATUS. A J Boult. (*O Knöfler* and *F Gebauer*, Germany.)

20,216 CHECK, STOP, and OTHER VALVES. G H Foster.

20,226 STEAM VALVE. J Lloyd.

10th November, 1892.

20,238 PETROLEUM and OTHER HYDRO-CARBON MOTORS. S Griffin.

20,239 ANTI-FRICTION SLIDE or GILDING BLOCK. P Pfeiderer.

20,265 BOILER TUBES of the LANCASHIRE and CORNISH TYPES. J L Major.

20,302 BENDING, SHEARING, and PUNCHING MACHINES. H O Bennie.

20,306 FURNACES. T E Caddy.

20,311 ELECTRIC ENGRAVER. C E Braun and F Wilde.

20,312 PISTONS. W Mather and T Thorp.

20,316 ELECTRIC LIGHTING. H Clegg.

20,318 TREATMENT of COMPLEX ORES CONTAINING SULPHIDES of ZINC, LEAD, IRON, ETC. A Guthrie and R F Macfarlane.

20,323 CALCULATING APPARATUS. L R Higgins.

20,333 PROTECTING TRANSFORMERS from LIGHTNING and from ELECTRIC CURRENTS of EXCESSIVE STRENGTH. C E L Brown.

20,337 MOTORS and MACHINE TOOLS DRIVEN by COMPRESSED AIR.* R Telschow.

20,341 GASEOUS FUELS. P A Fichet and R Heurtey.

20,343 DELIVERY NOZZLES for SPRAYING and SPREADING LIQUIDS. O Hoffmann.

20,348 ELECTRIC BATTERY CELLS. R J Black.

11th November, 1892.

20,357 TOOL and HOLDER for BORING ANGULAR HOLES. T W Barber.

20,359 JAW CHUCKS for LATHES. T W Barber.

20,360 ELECTRIC ARC LAMPS. R A Goodman.

20,361 SIGNALLING on RAILROADS and TRAMWAYS. F W Hirst.

20,365 STEAM HAMMERS. F H Stacey and H Wilkinson.

20,371 AUTOMATIC ELECTRICAL RAILWAY SIGNAL. A G Burrell.

20,383 INGOT MOULDS. C J Bagley and L Roberts.

20,385 SPRING ROLL for ROLLER JOURNAL BOXES. J W Hyatt.

20,386 ENGINE PACKING. J Currie.

20,398 APPARATUS for DISCHARGING WATER from STEAM GENERATORS. D B Morison.

20,399 APPARATUS for STARTING and RESTARTING TRAMCARS. T Charlton.

20,413 EXPLOSION ENGINES. T Ryland.

20,415 MICROPHONES. J T Gent and others.

20,419 PICKLING IRON and STEEL PLATES. Woodhouse and Rawson United Limited and W S Rawson.

20,422 AIR PUMPS. Siemens Bros. and Co. Limited. (*Messrs. Siemens and Halske*, Germany.)

20,445 ELECTRIC METERS. C Raab.

20,453 STEAM BOILERS. W M Walters.

12th November, 1892.

20,460 APPARATUS for SUPPLYING FUEL to STEAM BOILER FURNACES. J Whitehead.

20,475 APPARATUS for the SIMPLE COMPRESSION of PISTON RINGS, ETC. W H Hardy.

20,478 COMBINED AUTOMATIC CHARGING SWITCH and CUT-OUT. R Carryer.

20,488 CLOSING an ELECTRIC CIRCUIT by the PASSAGE of a TRAIN OVER a LINE of RAILWAY, and RECORDING APPARATUS CONNECTED THEREWITH. F W Webb and A M Thompson.

20,489 APPARATUS for STERILISING and OXIDISING LIQUIDS by ELECTRICITY. A B Woakes.

20,494 APPARATUS for FILTERING FEED WATER for STEAM GENERATORS. D A Rankine.

20,504 CONVERTING TO-AND-FRO VERTICAL MOTION into CONTINUOUS ROTARY MOTION. A P D Leval.

20,505 ALTERNATING CURRENT MOTORS. W L Wise. (*The Maschinenfabrik Oerlikon*, Switzerland.)

20,509 MOTOR. M W Lowinsky.

20,521 RATCHET MECHANISM SUITABLE for DRIVING LUBRICATING PUMPS. R J Werner.

20,522 HOT AIR MOTORS. H S Maxim.

20,525 WATER GAUGES. F A Hopkinson.

Manuscript Specifications of Patents can be examined at the Patent Office, London, after the Complete Specification has been accepted, on payment of 1s. The printed Specifications are usually published in about one month after acceptance of the Complete Specification, and any single copy may be obtained by remitting 8d. in stamps (or by special post cards sold at the Post Offices at 3d. each) to SIR H. READER LACK, *Comptroller General, Patent Office, 25, Southampton Buildings, Chancery-lane, London. When a number of Specifications are required, remittances may be made by P.O.O.*

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SMITHFIELD CLUB SHOW, 1892.

As the forthcoming Smithfield Club Show, to be held Dec. 5th to 9th, will doubtless include many exhibits of interest to our readers, we intend to deal very fully and promptly with the matter, and for this purpose we shall issue with "The Mechanical World" for Dec. 16th

A SPECIAL SUPPLEMENT,

in which the various exhibits will be dealt with by practical writers of acknowledged ability.

Although this SPECIAL SHOW NUMBER will entail great additional expense, the price of the Journal will still be One Penny.

Intending exhibitors will oblige by communicating with us without delay, in order that full justice may be done to their specialities by our editorial representatives.

We would point out that as the ORDINARY circulation of "The Mechanical World" now exceeds 20,000 copies weekly the value to exhibitors of descriptive notices in this special issue cannot be overrated.

FRIDAY, DECEMBER 2ND, 1892.

The Lephay Luminous Compass.

A CONSIDERABLE amount of attention has been attracted by a new form of luminous compass invented by Lieut. J. Lephay, of the French Navy. It consists essentially of an ordinary Thomson compass, and differs but little from the usual arrangement so far as its use in daylight is concerned. The card may, if desired, be illuminated at night in the usual manner, so that in the event of any failure of the Lephay apparatus the compass may be used in the ordinary manner. By using a combination of lenses and mirrors, M. Lephay throws from the binnacle lamp a vertical line of light upon the interior side of the compass box, between the card and the glass. This line, which may be produced upon any desired point of the inside of the periphery, is, for the time being, a fixed line, and bears a known relation to the line of the ship's keel. From another combination of lenses and mirrors above the centre of the card, M. Lephay throws upon the interior side of the compass box a second ray of light, which, when the apparatus has been properly adjusted, moves round as the card moves. This line, being of a different length, is easily distinguishable from the other one, and it may be temporarily set so as to bear any desired relation with any point on the card. In steering, all the helmsman has to do is so to use his wheel as to keep the two lines in one. The officer of the watch, instead of ordering a certain course to be steered, uses the ordinary illumination of the card, and by its aid heads the ship exactly to the desired point. He then, by means of buttons fitted for the purpose, moves the lines of light so that, the ship being on her course, both are in one; and having done this he shuts off the ordinary illumination and leaves the card in darkness. The steersman, from that time until the course may be altered, need only take care that he sees before him one line and not two. The officer can alter the course without again looking at the card, by turning a button to the extent desired, and the line, which is not subject to the motion of the card, appears in a new place. By means of the helm the other line is then made one with it, and the course is changed as desired.

A New Dirigible Balloon.

ONE of the most indefatigable workers at the problem of aërial navigation by means of dirigible balloons is the Commandant Renard, director of the central establishment of military balloons at Chalais-Meudon, France. Considerable attention was attracted some seven years ago by experiments made by this investigator with the dirigible balloon, "La France." Since that time he has been engaged in perfecting a propelling mechanism which will be tried at an early date. The new balloon is cigar-shaped like its predecessor, "La France," and measures 70 metres from tip to tip, with a diameter of 13 metres and a capacity of 3400 cubic metres. The car, which is constructed of bamboo and steel, contains a cabin for the machinery and men. The motor employed is worked by means of gasoline and balloon gas, and develops 45H.P. during eight to ten hours. It is able to drive the balloon at a speed of 40 kilometres an hour, or 11 metres a second. The total weight of the machinery with the carburator, the gasoline, and accessories, will not exceed 1200 to 1400 kilogrammes, or 30 kilogrammes per horse-power. Hitherto petroleum motors of large size have weighed 150 to 200 kilogrammes per horse-power; but M. Renard has been able to reduce the figure by a new arrangement, which is at present not to be described. The screw propeller is placed in front of the car and the rudder behind. It is expected that the trial ascent will be made during fine weather in the early part of next year.

Transmitting Signals Through Space.

SOME interesting experiments are being conducted by the chief engineer and electrician to the Metropolitan Post Office, the object being to transmit signals to distant points without the use of intervening wires or other conductors. Mr. Preece has already dealt with this subject at meetings of the British Association, and the experiments in question are being directed towards the transmission of signals, etc., between lightships and the shore by means of induction. The tests were proposed to be carried out in three different ways. The first was to erect a wire along the shore on light standards for a distance of about a mile, and a second wire from stem to stern of the ship, the two wires acting upon each other inductively through the intervening space when a current is passed along one. The second method was to suspend a short line over the side of the ship, so that it might dip into the sea in the direction of the end of the shore line, to work by conduction through the sea. The third plan was to pay out a light cable from the shore to the ship, terminating in a coil at the bottom of the sea, near the ship, but not attached to it, whilst another coil is placed on the vessel. These two coils are expected to act inductively, and to give ample sound on telephones by means of rapid alternations. These, then, are the three methods, but only the first has been tested at present. This has been done at Lavernock Point, a little to the south of Cardiff. The shore wire was erected here, and was supported for a mile in the direction of Lavernock House. The lightship, in this instance, was represented by the island of Flat Holme, in the Bristol Channel. The line put up on the island was arranged parallel to that on the shore, but three miles distant from it, and it was only half-a-mile in length. A generating machine was installed at Lavernock Point for the shore line, whilst the line on the island was provided with a sounder to receive the messages. It was found that the words transmitted along the land line were distinctly heard on Flat Holme. Thus communication was established between these two points, although separated by three miles, and this method could, it is claimed, be practically carried out independent of the condition of the weather. The experiments were satisfactory, but it may be mentioned that others of a somewhat similar nature were conducted before 1887 by the late Mr. Willoughby Smith, and since then by his son, at the Needles. The necessity for establishing a ready means of communication between lightships and the shore, independent of the weather, is great, and we shall await with interest the continuation and completion of the series of experiments which Mr. Preece, with the sanction of the Postmaster-General and of the Treasury, has undertaken.

An American Quadruple-expansion Engine.

JUDGING from present appearances, the quadruple-expansion engine will not long remain a novelty for power development on land. There are already several working in this country; but, so far as we are aware, to America belongs the credit of first using the quadruple engine for central-station purposes. The Dixon Manufacturing Company, Scranton, Pa., is constructing a large engine of this type for the Edison Electric Illuminating Company, of New York City. The steam pressure is to be 210lb. per square inch, and the engine is to develop 2500I.H.P. The cylinder diameters are 26, 37, 52, and 72in. dia., with 36in. stroke, and the speed will be 100 revolutions per minute, or 600ft. piston speed. The engine will be of the vertical inverted type, with the cylinders arranged in two tandem pairs, and the cranks 90 degrees apart. The dynamo to be run by this engine will be built up on the main shaft, which will, in fact, form the fly-wheel of the machine. No doubt the degree of success which attends this venture will largely influence the use of quadruple engines for central stations, for which purpose they appear to be well adapted.

From the Tannery to the Dynamo.

(*Concluded from page* 182.)

THE leaching and grinding of the bark is an important factor in a tannery. The large pieces of bark taken from the oak tree are thrown into a hopper-shaped mill or grinder, which resembles a coffee grinder on a large scale. The moss on the outside of the bark creates a great deal of dust, and contains little or no tannin; but it cannot be severed from the rind which really contains the acid. From the bark mill the ground bark is elevated into large tubs which have false bottoms or receivers underneath, to take up the tannin liquor. After a tub is filled with ground bark, a rotary sprinkler is set in motion to saturate the bark with a spray of water or liquor, which percolates through the ground bark, and on its way to the bottom catches up the tannic acid contained in the bark. At times warm water is used to facilitate the operation; also weak tannin liquor is used sometimes with good effect. However, old-school tanners prefer cold water, which they claim makes purer and sweeter tannin liquor. After the receivers at the bottom of these tanks are filled, the contents are pumped into large supply tanks, from which the liquor is distributed through the tannery as required.

The leaching process is the most interesting and valuable operation in the tannery, and upon its skilful management depends the financial success of the business. Opinions differ very materially as to the best method. The large round leach tubs, such as described, are the most popular now in use. However, many tanners still adhere (and with some success) to the old square pressed leach tubs, in which the ground bark is simply soaked or steeped in water and left for a length of time, until the tannic acid is extracted from the bark. Opinions also differ as to using steam or hot water. However, all have their merits.

Very strange and erroneous ideas prevail among those who use leather, and have no knowledge of the art of tanning. Certainly it is an art, and one of the oldest handed down to us. The general opinion prevails that leather made in "ye olden time" is superior to ours of the present time; but such is not the case. In fact, the fundamental process of tanning to-day is precisely the same as that of a thousand years ago, except that we enjoy improved machinery and appliances which further the process and improve the material. What took our forefathers from fourteen months to about two years, we accomplish in from four to six months, and the quality of leather is as good if not superior to the leather made a hundred years ago. With the aid of steam and power we can facilitate the process and shorten the length of time to produce the leather. The "olden-time tanneries" had the lay-away vats in the yard exposed to the elements, and in rainy and inclement weather, as well as during the winter, the tanners could not do any work, and left the leather lying in the vats, generally to the detriment of the stock. In our present improved and model tanneries everything is done under cover, even the bark is put under sheds to keep it dry, and good leather is tanned within four months. However, belt and prime harness leathers generally take six months.

When the leather is taken from the last layer of bark, it is oiled on the grain and hung up in a darkened room to dry. To obtain a nice clear russet colour, the place must be kept at an even temperature and very little heat used. After the leather is thoroughly dried, it is put up in rolls containing five butts (hides) each, and whenever a carload is ready it is shipped to New York. Here it is again examined and weighed, and all butts not suitable for belting are thrown out and finished into sole leather for shoe purposes.

The perfect hides for belting are soaked in warm water, and the centre part cut out and used for prime belting. The waste or offal is finished and rolled for shoe purposes. When the pieces are thoroughly scoured and cleansed, they are oiled on the grain and hung up to dry, and when in a semi-dry condition they receive a coat of stuffing made of equal parts of cod oil and beef

tallow. This is done to preserve the leather and make it pliable for the transmission of power. After the stuffing has entered the pores, which takes about twenty-four hours, the leather is subjected to great strain in large stretching machines. Great care and good judgment must be manifested in this part of the process. Each piece of leather must receive an equalising strain because of the peculiar formation of the hide, the fibres being very fine and closely knit together on the back of the animal, and running coarser and thicker towards the flanks. It is of the highest importance, for belts intended for electric-light plants, to have an equal tension over the entire surface of the belt. Therefore, the stretching process of belt leather needs the utmost care, and should receive the closest attention. After the pieces of leather are thoroughly stretched, they are worked smooth on the grain side, and both by hand and machine labour are set down as solid and compact as possible. Then they are put into a drying room and thoroughly dried. Afterwards one edge of the pieces is straightened, and they are then cut into whatever width of belt they are best suited for. The pieces of each width are matched accurately as to thickness, and then the laps (joints) are cut by a machine. The edges of the laps are feathered, and the joints cemented (glued) together, and pressed under a hydraulic press, which pressure is considered the best by all first-class belt makers.

Rivets are now rarely put into belts. A double belt well cemented is good for all ordinary purposes, and rivets are superfluous. However, certain fastenings, such as endless copper wire screws, which do not obstruct the surface or unnecessarily stiffen the belt, are a benefit; especially when the belt comes in contact with water or too much oil, this fastening prevents the belt from coming apart, and holds the leather firmly together.

All main driving belts over 40in. in width have to be made in sections, consisting of two or more pieces of leather cemented together. The average hide for belting does not contain more than 40in. in width of solid leather suited for belting—very rarely over that; therefore, wide main belts are made in sections. Ordinarily the pieces are not lapped parallel, but simply butted. For example, a 60in. double belt receives two 30in. pieces for the first layer, laid side by side, and a 30in. piece over the centre of the two lower pieces to break the joint, and two 15in. pieces on top of each edge of the lower layer to complete the width; thus the belt is cemented together. However, for electric-light plants, where belts are run at high speed and with variable power (which produces sudden strain), the seams of these butted joint belts, in several instances, broke, doubled up and destroyed the belts completely. To guard against such a calamity it is considered advisable to make wide main driving belts with parallel joints. For example, a 60in. double belt will be made of two 33in. pieces joined parallel, with a 3in. lap, making one solid piece 60in. in width, and on the upper part put a 33in. piece in the centre, and two 18in. pieces on the edges, all joined with parallel laps; this cemented together will make a 60in. double belt with unbroken surface, and as one solid piece of leather having a uniform tension and able to withstand an equal strain over the belt transversely as well as parallel, and thus will prevent such large, heavy driving belts from collapsing at the parallel joints. Everyone must admit that main belts made on this plan are superior, and more reliable, and would come into general use if it were not for the additional cost of labour and material in making them.

Leather being by nature an absorber of moisture, belts must be guarded against exposure to oil. In electric-light and power plants much mineral oil is used, and the great velocity at which the belts are run seems almost imperceptibly to suck or draw the oil from the journals of the engines and dynamos, and allow it to be absorbed by the belts, which get completely saturated with oil, and in a short time rot and destroy the fibre of the leather. Various methods have been used to overcome this difficulty. One of the most successful is a certain composition or belt dressing which is rubbed over the surface of the belt, and closes the pores of the leather. No foreign substance can penetrate a belt treated with this compound, and the belts last much longer and give better service. With perforated belts this compound does not seem to be so effectual, because the perforations naturally expose the inner part or the heart of the leather, which is very porous; however, the surface of the belt being covered, it shields that part of the leather which comes in contact with the pulleys, and the current of air passing through the perforations protects the belt to a certain extent, and that class of belt runs smoother, with less friction, and is more reliable.

And now, gentlemen, we have reached the point where another curious and erroneous idea prevails among many engineers—namely, that belting should be made of pieces only 4ft. in length; as if all hides were of the same length and texture. It will surprise these men to learn that there are no two hides alike; they vary in some particular point. Hides exist which will make almost 6ft. of sound solid leather below the shoulder, and, again, some hides will not make 4ft. of solid length; the only safeguard is to specify belting made of leather cut below the shoulders of the hide irrespective of length.

Now, gentlemen, I have endeavoured to show you, in this paper, the various processes and changes to which a hide is subjected in its travels from the "tannery to the dynamo."

The Under-type Stationary Engine.—XXI.

We now give illustrations and a table of dimensions of boilers of the flush-top locomotive type, from 12 to 50H.P. inclusive.

Fig. 35. Fig. 36.

Fig. 35 shows a longitudinal section of the boiler, and Fig. 36 gives a half-end elevation and half-transverse section through the firebox.

TABLE OF DIMENSIONS OF LOCOMOTIVE BOILERS.

Nominal horse-power	—	12	14	16	20	25	30	35	40	45	50
Working pressure in lb.	—	80	80	80	100	100	100	100	100	100	100
Hydraulic test press. in lb.	—	160	160	160	200	200	200	180	180	180	180
Length of outside firebox	A	3ft. 10in.	3ft. 11in.	4ft. 1in.	4ft. 1in.	4ft. 3in.	4ft. 10in.	5ft. 3in.	5ft. 6in.	5ft. 9in.	6ft.
Length of inside firebox	B	3ft. 3in.	3ft. 4in.	3ft. 6in.	3ft. 6in.	4ft. 1in.	4ft. 3in.	4ft. 8in.	4ft. 11in.	5ft. 2in.	5ft. 5in.
Height of inside firebox	C	3ft. 6in.	3ft. 10in.	3ft. 10in.	4ft.	4ft. 3in.	4ft. 6in.	4ft. 6in.	4ft. 9in.	4ft. 11in.	5ft.
Height of outside firebox	D	5ft.	5ft. 6in.	5ft. 6in.	5ft. 9in.	6ft.	6ft. 6in.	6ft. 9in.	7ft.	7ft. 3in.	7ft. 6in.
Width of outside firebox	E	3ft. 2in.	3ft. 6in.	3ft. 6in.	4ft. 3in.	4ft. 3in.	4ft. 9in.	4ft. 9in.	5ft.	5ft.	5ft. 3in.
Width of inside firebox	F	2ft. 7in.	2ft. 11in.	2ft. 11in.	3ft. 8in.	3ft. 8in.	4ft. 2in.	4ft. 2in.	4ft. 5in.	4ft. 5in.	4ft. 8in.
Diameter of barrel	G	3ft. 1in.	3ft. 5in.	3ft. 5in.	4ft. 2in.	4ft. 2in.	4ft. 8in.	4ft. 8in.	4ft. 11in.	4ft. 11in.	5ft. 2in.
Length betwn. tube-plates	H	6ft. 9in.	7ft. 3in.	7ft. 9in.	8ft. 3in.	8ft. 9in.	9ft. 3in.	9ft. 9in.	10ft.	10ft. 6in.	10ft. 9in.
Width of smokebox	—	1ft. 7in.	1ft. 10in.	1ft. 10in.	1ft. 10in.	2ft. 2in.	2ft. 2in.	2ft. 5in.	2ft. 5in.	2ft. 6in.	2ft. 6in.
Length of boiler over all	I	12ft. 2in.	13ft.	13ft. 8in.	14ft. 2in.	15ft. 7in.	16ft. 3in.	17ft. 5in.	17ft. 11in.	18ft. 9in.	19ft. 3in.
Diameter of chimney	J	12in.	15in.	15in.	15in.	20in.	20in.	22in.	22in.	24in.	24in.
Number of tubes	—	40	45	50	60	65	75	85	80	85	90
Diameter of tubes	—	2½in.	2½in.	2½in.	2½in.	2½in.	2½in.	2½in.	3in.	3in.	3in.
Diameter of smokebox	—	3ft. 5in.	3ft. 9in.	3ft. 9in.	4ft. 6½in.	4ft. 6½in.	5ft. 0¼in.	5ft. 0½in.	5ft. 3½in.	5ft. 3½in.	5ft. 6½in.
Firebox heating surface in sq. ft.	—	46·79	55·01	56·86	69·00	75·01	84·60	96·42	103·2	112·63	120·85
Tube heatg. surface in sq ft.	—	176·40	213·30	253·00	317·40	372·60	453·00	575·45	628·0	700·40	758·70
Total heatg. surface in sq. ft.	—	223·19	268·31	309·86	386·40	447·61	537·60	671·87	731·2	813·03	879·55
Grate area in sq. ft.	—	8·38	9·69	10·18	12·81	14·93	17·68	19·38	21·65	22·75	25·21
Size of firehole	—	10in. × 12in.	12in. × 16in.	12in. × 16in.	12in. × 16in.	13in. × 18in.	13in. × 18in.	13in. × 18in.	13in. × 18in.	13in. × 18in.	13in. × 18in.
Diameter of manhole	—	15in.	15in.	16in.	16in.	16in.	16in.	16in.	17in.	17in.	17in.
Size of mudholes	—	2½in. × 3½in.	2½in. × 3½in.	2½in. × 3½in.	2½in. × 3½in.	2½in × 3½in.	2½in. × 3½in.	2½in. × 3½in.	2¾in × 3¾in.	2¾in. × 3¾in.	2¾in. × 3¾in.

THICKNESS OF PLATES IN INCHES.

Firebox shell sides and top	—	5/16	5/16	5/16	5/16	7/16	7/16	7/16	7/16	7/16	7/16
Firebox shell front	—	5/16	5/16	5/16	5/16	7/16	7/16	7/16	7/16	7/16	7/16
Firebox shell back	—	5/16	5/16	5/16	5/16	7/16	7/16	7/16	7/16	7/16	7/16
Barrel	—	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16
Inside firebox sides and front end	—	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	7/16	7/16
Firebox and smokebox tube-plates	—	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16
Smokebox barrel	—	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16
Chimney	—	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16

There are several points of detail respecting these boilers which we must describe in our next article.

(To be continued.)

Reamers.

Reamers are made of various shapes and kinds. There are the standard straight pattern, standard tapers of different degrees, and special shapes innumerable. The first-named is one of the most particular of all the tools used in a machine shop, as on its accuracy and good condition—and, of course, proper use—depends the accuracy of all holes and parts working in them. The admirable modern system of duplication and interchangeability of parts would be manifestly impossible unless the greatest care and necessary facilities for absolute exactness of sizes were used, and the reamer is one of the most important factors for maintaining the desired accuracy. As a properly-equipped toolroom will always contain a set of standard male and female gauges, a frequent testing of the reamers is conveniently made, and should be, as a very slight amount of wear on the keen edges of the tool will make a very perceptible difference in the size, and thereby destroy the accuracy of interchangeable fitting, which will defeat the object of the system. There are many different makes and patterns of reamers in the market, some of which contain alleged improvements of one kind or another which are claimed to make them much better than the ordinary form. That the latter, however, is capable of doing as good work as it is possible to do with any of the innovations can hardly be questioned, and it is always a good rule to stick to a good thing when we have it. Many of the best shops prefer to make, rather than buy, their standard reamers, although for less accurate work they will use the manufactured ones on account of their lesser cost.

It is important to select only the best quality of steel obtainable, having the greatest possible uniformity of temper and homogeneity. By some tool makers the mild-centred steel is preferred, as it is stronger and less liable to break in hardening. Before using, the forgings should be very carefully annealed, as it has considerable influence on the after operation of hardening. The centres should be drilled and countersunk—the drilling not unnecessarily deep—and the ends squared perfectly true, except that there should be a slight depression at the centre to protect it from injury. The turning should be slightly above size, to allow for finishing by grinding. For the grooves the form given by standard cutters is correct, but as the tool is only intended for the merest scraping cut, there is no necessity for making them deep, and it is much better not. Always make an odd number of grooves, as if an even number be used it brings the cutting edges opposite to each other, which will cause the tool to stick and chatter, and work badly in all respects. The edges should be made quite thin, say $\frac{1}{16}$in. for sizes from 1in. to 2in. The number of grooves should be sufficient to retain the approximately circular form, and not that of a polygon. Of course, if there be no milling machine, the grooving may be done on the shaper or planer, on the ordinary index centres; but in order to secure the desirable uniformity of depth of grooves and thickness of teeth, it will be best to go around first with the roughing cut, feeding down slowly and gauging the depth by a mark on the collar of the feed screw corresponding with one on the bearing. After completing the roughing cut for all the grooves, the tool should be ground and given a keen edge with a fine Washita or other good oilstone, and carefully reset. Then feed down to a mere scraping cut, fasten the feed screw and index around the entire number of grooves without changing the position of the tool. This will give uniformity and smoothness, and will obviate the necessity for any but the slightest amount of filing or other method of finishing to give the required smoothness of surface.

Of course it is assumed that, in the absence of a milling machine, other improved facilities for this class of work would also be lacking, and that hand finishing would be necessary. Where they are available, however, it may be omitted and the finishing be done after hardening. The tool should be recessed as low as bottom of grooves for about $\frac{3}{4}$in. on a 1in. reamer, extending upward from the top end of the teeth. The square at top upon which the wrench fits should be carefully finished—preferably milled on the index. Leave a slight amount of the round to prevent sharp corners, and the top edges chamfered, to facilitate its entering the wrench. In hardening the heating is best done in a charcoal fire, slowly and uniformly, and the tool plunged quickly into a bath of fresh soft water, so that the entire neck is immersed, and kept moving steadily in a circular motion until perfectly cold. If springing is to be avoided the tool must be carefully poised in a vertical position, over the bath, within one or two inches of the surface, and plunged in the full length of body, with as quick a movement as possible. It is also important that it be kept in water until the temperature is as low as the latter will make it, for, if withdrawn prematurely, there is great danger of hearing that sharp little "click, click," which means disaster in the shape of a cracked and spoiled reamer.

After withdrawing it from the bath, the tool is best tempered as soon as convenient, as there is always more or less danger from shrinkage strains, and consequently cracks, until the equalisation by drawing is accomplished. For most makes of steel the colour should be a clear straw yellow, and, in order to avoid the danger of being misled by the uncertain indications of the colour guide, it is well to have a fine float file handy with which to test the hardness as the drawing proceeds. This should be done on all parts of the reamer, to make sure it is not progressing more rapidly in some parts than others. There are several methods of doing this heating—viz., the muffle, the sand bath, holding over the forge fire flame, and others of a crude and uncertain nature. The two first named are very good if intelligently used; if not, they are capable of atrociously bad results. The point to be particularly observed is slowness of heating, and as a means to this end, the temperature of the muffle or bath should be but slightly higher than that necessary to impart to the steel to give the desired temper. By this means the heat has a chance to become absorbed gradually and uniformly by the entire mass of the reamer; whereas if the heating medium be of a much higher temperature, the thermal conductivity of the metal will be insufficient to prevent the thinner portions (the teeth) from becoming heated above the degree required, and consequently the essential portion of the tool will be made too soft, while the body of the metal is much too hard. This is the greatest objection to the method of heating over the flame, although by the exercise of exceptional skill it may be made to give very satisfactory work, by manipulating the tool so as to give the heat a chance to equalise. The safest plan is to dip the tool—preferably in oil—as soon as the required temper is reached, as the drawing does not stop immediately on withdrawing from the heat, and there is danger of its running too low.

The tool is then ready for finishing ... with improved facilities, this will ... in placing it on the index centres ... grinding machine and grinding the gro... true and clean, obliterating all tool marks, and giving a sharp edge to the faces of the teeth. The next operation will be to place on the centres in the grinding lathe and grind the entire length, from the end of the teeth to the square at the top—the body above the neck being just the barest shade smaller than the diameter of the teeth, and the latter tapering slightly at the point. The last and all-important move is giving the necessary clearance to the teeth, back of the edge. It is safe to say that there are more badly-working reamers from want of a proper knowledge or appreciation of this fact than from any other cause, or all others combined. The usual fault is too much—many times too much! And the result is that the cut is so rank as to cause the reamer to stick and jamb—cocking first on one side of the hole and then on the other,—jumping and chattering all the way through; and finally, when withdrawn, an examination of the hole shows it to be much larger than the reamer, and of a cross section which might be geometrically described as an "irregular" polygon. This is not an overdrawn view of the matter, as may be affirmed by any observant machinist of average experience. But, on the other hand, the same reamer, with proper clearance, will not only work smoothly and easily, leaving a clean bright hole, but the all-important item of size is absolutely assured—that is, the hole will be the size of the reamer, no larger, and certainly not smaller.

Now, as to the method of giving this clearance, of course there are more than one, but certainly none better as to results nor more easily accomplished than the following:—After the cylindrical grinding, leaving the reamer on the centres, take a good sharp-cutting Washita oilstone, and by hand, stone back the clearance by starting near the edge and working carefully to avoid touching the one back of it; stone the whole length of the tooth, increasing the amount of clearance uniformly from nothing at edge to the back. It is astonishing how very little stoning will give the desired result, and though the method may be an antiquated one, modern improvements have, so far, failed to excel it. A reamer so made, of course, is only intended for hand use, and for the removal of only so much metal as is a proper cut for standardising the hole. It works equally well in all kinds of metal, and if used with plenty of oil, will be very durable, retaining its edge and size for a long time. In use for cast iron, the size of hole may be varied by the use or omission of oil. With it, the reamer will cut what may be termed "normal" size, whereas if used dry the hole will be a shade larger.

Where there are no facilities for wheel grinding, another old-fashioned method may be resorted to as a very efficient substitute. Place the reamer on the centres of an ordinary engine lathe, and the aforementioned oilstone in the tool rest, where it may be held firmly in the position of a turning tool by placing wooden liners at the top and bottom, and placing a tool across it, passing through the tool post and the other end, supported by a block or anything of proper height to make it parallel. The screw of the tool post can then be set down carefully and the stone will be held very securely. Run the lathe backward on the fast speed, feed the stone up to the work very carefully, and as soon as it touches, feed back and forth quickly, by hand, the entire length of teeth and shank, feeding up the stone very gradually until it has worn to a good wide bearing. The caliper or standard ring gauge should be used frequently, as the stone cuts much more rapidly than would be supposed, and after it is once made too small it is exceedingly difficult to make it larger again. After the proper size is reached the clearance can be stoned as desired. It need hardly be said that it is utterly impossible to make a reamer for accurate work by finishing it before hardening, as even an infinitesimal amount of springing during the process will be very perceptible in the size of hole. There is no shop so poorly equipped but that good work may be turned out by competent workmen, and it is in the fertility of resource, as well as by skill in manipulation, that the latter are distinguished. The number of tools whose sizes are fixed, and upon which the accuracy of work depends, is not large, and there is no excuse for their not being made and kept of the proper size. It certainly pays to put a small amount of expense into facilities for decreasing that of the work for which they are intended, and it is very short-sighted policy which fails to recognise this fact, and act on it.—"Iron Age."

Sugar-making Machinery.

XXIV.

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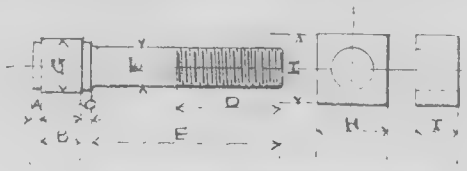
In a mill having rollers 24in. diameter by 48in. long, the top roller bearings will be 8in. diameter by 10in. long, and the cover bolts 3¼in. in diameter. The load on the journal will be $8 \times 10 \times 1500 = 120{,}000$lb. The net sectional area of the two bolts $= 12{\cdot}8$ sq. in. The load per square inch on the bolts $= \frac{120{,}000}{12{\cdot}8} = 9400$lb. nearly, giving a factor of safety for steel bolts of $\frac{67{,}200}{9400} = 7$ fully. The diameter of the side roller bolts when two for each cap are employed is from $\frac{1}{10}$th to $\frac{1}{8}$th of top cover bolts.

Table XVII. gives the dimensions for the set screws for a number of sizes of small mills (Fig. 50).

Table XVIII. gives the dimensions of the journals and the various bolts used in connection with sugar mills, which require no further description.

Table XIX. gives similar dimensions, and also particulars of the rollers, pinions, etc.



Sugar-making Machinery.—Fig. 50.

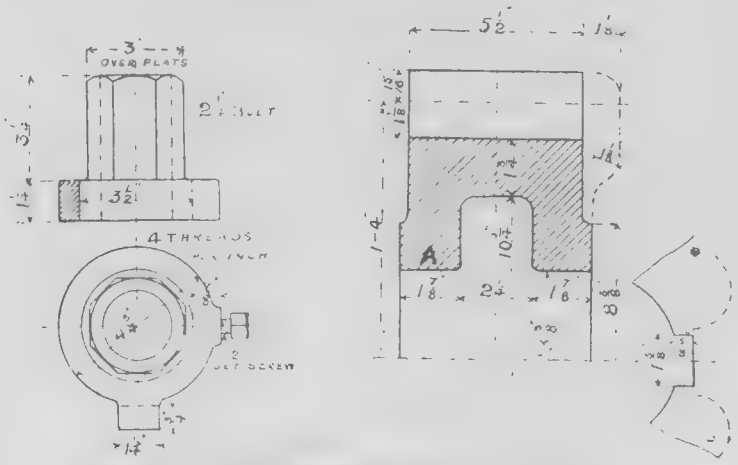


Fig. 51. Sugar-making Machinery. Fig. 52.

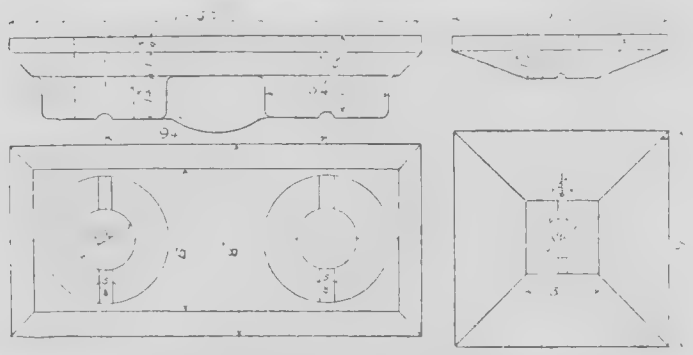


Fig. 53.—Sugar-making Machinery. Fig. 54.

The nuts for the top roller main bolts are usually made of gun metal, and generally octagonal in shape. Their depth is usually twice the diameter of the bolt. Fig. 51 shows one of these nuts with cast-iron locking ring for a small mill, having rollers 16in. diameter by 24in. long. The locking ring has a projecting lug which engages with the flat side of the cover, preventing it from turning round, the nut being held in position by the small set screw shown.

Roller Pinions.—In Table XIX. are given the pitch, breadth, and number of teeth of the roller pinions for a number of sizes of mills. These pinions are generally cast of a good mixture of hæmatite and cold blast iron. In the larger sizes of mills they are now very often made in cast steel, being much stronger, and they are usually flanged to the pitch line on both sides.

TABLE XVIII.—DIMENSIONS OF SUGAR-MILL JOURNALS AND BOLTS.

Mill Rollers.		Journals.		Diameter of Bolts in Inches.					
Diam. in.	Length. in.	Diam. in.	Length. in.	Side Covers.	Top Covers.		Bed to Foundation.		Cheeks to Bed.
				Parallel.	Ends.	Middle.	Ends.	Middle.	Parallel.
16	28	5½	5½	1½	2½	2½	1⅜	1¼	1⅜
18	30	6	7	1⅝	2⅝	2¼	1⅝	1½	1½
20	36	6¼	7	1¾	2¾	2½	1¾	1⅝	1⅝
22	45	7½	8½	2	3	2⅝	1⅝	1¾	1⅝
24	48	8	10	2¼	3¼	2¾	1⅜	1⅝	1⅜
26	60	9	12	2⅜	3⅜	3	1⅞	1⅜	1⅞
28	54	10	13	2½	3⅝	3¼	2	1⅞	1⅝
30	60	12	14	2¾	4	3½	2	1⅜	2
32	66	12½	15	3	4½	3¾	2¼	2	2¼

TABLE XIX.—DIMENSIONS OF SUGAR MILLS.

Rollers.		Gudgeons.			Pinions.			Bolts.		
Diam.	Length.	Centre to Centre. Journals.	Diam. Top Journal.	Diam. Side Journal.	Pitch.	No. of Teeth.	Breadth.	Diam. Top Cover.	Diam. Side Cover.	Set Screws.
			Mid. End	Mid. End						
in.	in.	ft. in.	in. in.	in. in.	in.		in.	in.	in.	in.
10	17	2 2	3½ × 4½	3½ × 4½	2½	14	3½	—	—	1½
14	22	2 8	4¼ × 5	4 × 5	2¾	16	4¼	—	—	1⅝
14	28	3 0	4¼ × 5	4 × 5	2¾	16	4¼	—	—	1⅝
16	22	2 8	4⅜ × ¾	4½ × 5⅜	2¾	20	4¼	2½	1⅜	1⅝
18	24	2 11	6 × 6½	5½ × 6½	2½	20	5	2½	1⅜	1⅝
18	36	3 11	6 × 6½	5½ × 6½	2½	20	5	2⅝	1⅝	1⅝
20	36	4 0	6⅝ × 7	5½ × 7	3⅛	20	6	3⅛	2¼	2
20	42	4 6	6⅝ × 7	5½ × 7	3⅛	20	6	3⅛	2¼	2
22	42	4 7	7¼ × 8½	6½ × 8½	3⅜	19	7	3⅛	2½	2
24	48	5 2	8 ×10	7½ ×10	3⅜	20	7	3⅛	2½	2
26	54	6 1	9 ×12	8 ×12	3½	21	9	3⅜	2⅝	2⅛
28	60	6 9	11 ×14	10 ×14	4⅛	19	10	4⅛	3¼	3¼
30	60	6 9	12 ×14	10½ ×14	4⅜	20	10	4¼	3½	3½
32	84	8 10	14 ×17	12½ ×17	5	20	14	5	3⅝	3⅝
34	72	8 10	14 ×17	12 ×17	5	20	15	5⅛	3⅝	3⅝
42	84	—	19 ×24	18 ×24	6	22	21	6	4⅜	4½

TABLE XVII.—DIMENSIONS OF SET SCREWS AND NUTS FOR SUGAR MILLS.

Diameter of Rollers.	A	B	C	D	E	F	G	H	I
10	⅝	1½	½	3½	6	1¼	1½	2¼	1⅜
12	⅝	1⅝	½	3½	7	1⅜	1⅝	2⅜	1½
14	¾	1½	⅝	4	8	1½	1⅞	2⅝	1⅝
16	¾	1⅝	⅝	4½	8½	1½	2⅛	3	2
18	¾	1⅝	⅝	5	9½	1⅝	2⅛	3⅛	2⅛
20	⅞	1¾	⅝	6	11½	2	2⅜	3¼	2¼

The number of teeth varies from 14 to 22, the object being to obtain as strong a tooth as possible. The length of tooth is made longer than for ordinary gearing wheels, on account of the alterations in the centres which may take place in the setting of the rollers. Sometimes the front or cane roll may be set nearer to, or farther away from, the top roll, thus altering the centres.

The length of tooth adopted is generally ⅓th of the pitch, and the breadth of tooth should be about equal the diameter of top roller journal. The pinions should be bored a fit for their respective shafts, and keyed on with two keys placed at right angles to each other. The breadth of the seating for the pinion as at A (Fig. 52) should equal the pitch. The illustration, Fig. 52, shows the roller pinion for a mill having rollers 16in. diameter by 24in. long. The top roller pinion is capped to the points on one side. The body of the pinion is cored out in the centre, but the metal is left in over where the keyseat is sunk.

Examples of the washer plates employed for the top cover bolts and the bolts for the baseplates, are shown in Figs. 53 and 54 respectively.

Sometimes in large mills the washer plates are formed out of plain slabs of wrought iron.

(To be continued.)

Corrugated Furnaces.

(*Concluded from page 207.*)

We have now to consider the claims put forward for corrugated furnaces on the grounds of increased strength and greater expansibility. It is of course obvious that, other things being equal, a corrugated plate is less liable to collapse from over-pressure than a plain one, for this peculiarity is largely taken advantage of in allsorts of iron structures. A matter so well known may be taken for granted, and we will turn our attention to the effect that this increase of strength has upon boiler furnaces. The most perfect structures are those which have all their parts of equal strength, like the wonderful "one-horse shay" which was so well constructed that after a hundred years all its parts crumbled into dust at the same moment. There is, therefore, no more need for a furnace tube to be stronger than the rest of a boiler than there is for one link of a chain to be stronger than the rest, after all the conditions of working have been taken into account.

Therefore, with the same thickness of plates as a plain one, corrugations would be of no advantage. But we can use a thinner plate when corrugated, and in this way enable the heat to pass through more rapidly to the water. This is a positive advantage to which there is no apparent drawback. We must, however, remember that of the two factors, external and internal resistance, the latter plays only a secondary part; for deposit of ⅛in. thick, whether on the fire side or water side of the plate, may retard the heat more than ⅛in. increased thickness in the plate itself. Though on a corrugated plate there may, as we have seen, be an increased liability to the formation of deposit, yet we may use as a set-off to this the greater facility of renewal of thin plates than of thick, when repair may be found necessary, and besides, in the matter of expansibility, yet to be considered, the thin plate has a decided advantage over a thick one, as it yields more readily to varying strains. Even in the matter of corrosion a thick plate is at a disadvantage. It might be thought that where there is much wasting a thick plate would be the better, for it would give a much greater margin of safety as it was being corroded away. This is not found to be the case. A thick plate is much more liable to have minute cracks on its surface while at work than a thin plate, especially where it is subjected to a bending strain.

On these bright surfaces the corrosive action readily seizes and eats away the metal. Then, though the part is thus thinned, it does not on that account transfer the surface cracks to the thicker parts; but because those thicker and stronger parts are near, it is made all the more liable to more surface cracks at the same place, and more corrosion.

In the case of foundry work this is well known, for where there are thick and thin parts near each other the thin parts are far more liable to crack when cooling than if all the parts were thin. It is exactly the same with furnace plates, for they also are exposed to alternate heating and cooling every time the boiler is blown out or restarted; and though the range of temperature may not be great, it is quite enough to throw undue strain upon parts least able to bear it. Therefore, to prevent the initial surface cracks from appearing, it is better to have thin plates than thick ones in a furnace, and so the corrugations come to the front as the best way of getting the required thinness. It has been urged by some that this greater thinness of plate means increased lightness, but this can hardly be the case, for there has to be a greater length of plate used when it is corrugated. This is easily seen when we look to the claim for increased heating surface, for increased surface means increased weight.

Now, while the strength of a boiler tube decreases according to the square of its thickness, its weight increases directly according to itsl ength, and in a corrugated furnace it will be found that, owing to the increased length made necessary by the corrugations, the weight will increase quite as rapidly as the reduced thickness of plate will diminish it. Thus on the score of lightness the corrugations do not make good their claim, though on the score of thinness, made possible by increased strength, their advantage is clearly seen.

We will now briefly glance at the advantages of superior expansibility. Where there is no breathing power in furnace tubes, grooving is almost sure to appear. Where there is no grooving at one end or the other of the furnace, edge cracks will probably be seen at the transverse line of rivets at one of the ends or both. Also, where there are one or more transverse seams above the fire edge cracks will be found there as well. When, however, there are no edge cracks and no grooving anywhere, the expansion cannot be improved on, and in these cases corrugated furnaces could not diminish what does not exist.

Owing to their form of construction and to their method of staying, marine boilers are as a rule more flexible than land boilers, and in a large percentage of them the expansion is all that can be desired. In those few instances, however, where grooving or cracks appear, it would in most cases be best, when repairing the boiler, to have the old furnaces removed and substituted by corrugated ones. There would then, in all probability, be no more trouble from this source. It must also be remembered that where grooving appears on the combustion chambers it may be due to the want of expansibility in the furnace, though the grooving may not be near it; for the defect will appear at the weakest place, even if it be a yard away. It may therefore be laid down as a general rule that where there is internal grooving anywhere in the boiler, or leakage of stays which returns again and again, the cause must be sought in the unnecessary stiffness of furnace in a longitudinal direction, and there must the remedy be applied, while in most cases it will be found that the insertion of corrugated furnaces will prove to be the remedy required.

The inquiry about stiffness is one that cannot be carried on purely by *a priori* reasoning, for where the defect lies elsewhere, say in undue rigidity of the combustion chamber itself, then corrugated furnaces, if inserted, will probably show signs of cracking transversely, and this, though not a serious defect, may prove troublesome. Each case has thus to be decided on its own merits, when the decision for or against corrugated furnaces must finally be made.

An automatic railway ticket-selling machine is in use by the Berlin City and District Railway. By putting a 10-pfennig piece (1½d.) into the slot a ticket is secured. It has been in use some time, and the result is stated to be very satisfactory to the railway company and to the public.

There has recently been completed an electric tramway for the North Hungarian Union Coal Mining Company, from the Johann Mine at Csibaj to Mizserfa, the loading station. The line is about 1¼ miles long, has a gauge of 2ft., and a speed of 10 miles an hour is attained. The electric locomotive is of 6H.P., and will draw from 18 to 20 wagons.

Machine Construction.

THE CONSTRUCTION OF MACHINE ELEMENTS.

(*Continued from page 16*

CHAPTER IX.

SHAFTING.

§ 144.

CALCULATIONS FOR CYLINDRICAL SHAFTING.

In machine construction those axles which are used to transmit twisting moments are called shafting.

In order to fulfil this purpose two requirements must be met; first, the ultimate strength must be sufficiently great, and, second, the torsional spring must be kept within proper limits. In actual practice, shafting is subjected not only to torsional stresses, but also to bending, due to the weight and pressure of gears, pulleys, levers, etc., which are carried. These latter influences will not be considered at first, and the calculations made only for round, solid wrought and cast-iron shafting. Let:

P = the force acting to rotate the shaft;
R = the lever arm at which it acts;
N = the horse-power transmitted;
n = the number of revolutions per minute;
d = the diameter of the shaft;
L = the length of shaft in feet;
δ = the angle of torsion in degrees;
S = the fibre stress at the circumference;
G = the modulus of torsion of the material = ⅖ of the modulus of elasticity.

We then have for strength:

$$d = \sqrt[3]{\frac{16}{\pi S}}\,PR \quad \ldots\ldots\ldots (129)$$

and for stiffness:

$$d = \sqrt[4]{\frac{32}{\pi G}\,\frac{12 \cdot L}{\delta^{\circ}}\,\frac{360}{2\pi}}\,PR \ldots\ldots (130)$$

In order to have the same security for the shafting as already given to journals, the value of S should be only ⅘ the fibre stress (see § 5), but in actual practice the stress is taken the same as for journals—viz., for wrought iron S = 8500lb., and for cast iron S = 4250lb.

This gives the following results for strength:—

For wrought-iron shafts,

$$d = 0{\cdot}091\sqrt[3]{PR} = 3{\cdot}33\sqrt[3]{\frac{N}{n}} \quad \ldots\ldots\ldots (131)$$

For cast-iron shafts,

$$d = 0{\cdot}114\sqrt[3]{PR} = 4{\cdot}20\sqrt[3]{\frac{N}{n}} \quad \ldots\ldots\ldots (132)$$

In taking the torsion of shafting into consideration the greatest allowable twist in degrees should not be over 0·075° per foot in length of shafting—that is, $\delta^{\circ} = 0{\cdot}075$ L, which gives for stiffness against torsion:—

$$d = 0{\cdot}3\sqrt[4]{PR} = 4{\cdot}7\sqrt[4]{\frac{N}{n}} \quad \ldots\ldots\ldots (133)$$

and for cast-iron shafts:—

$$d = 0{\cdot}357\sqrt[4]{PR} = 5{\cdot}63\sqrt[4]{\frac{N}{n}} \quad \ldots\ldots\ldots (134)$$

The quotient of effect $\frac{N}{n}$ is obtained from the relation to the statical moment P R as follows:—

$$PR = \frac{33{,}000 \times 12}{2\pi} \cdot \frac{N}{n} = 63{,}020\,\frac{N}{n} \ldots. (135)$$

From these formulæ the following table for round wrought-iron shafts has been calculated. An inspection of the table will show that it is quite possible for a shaft to be strong enough to resist permanent deformation, and yet be so light as to be liable to spring under its load. For example, a shaft 26ft. long, with a twisting force of 220lb. applied at one end, and acting with a lever arm of 20in., gives a turning moment P R = 4400in.-lb., which would require a shaft only 1¼in. diameter (see column 2). This, however, would permit far too much torsion, and in order that the angular deflection should not exceed the limit of 0·075° per foot, a corresponding value of P R in column 4 must be found, and against it in column 1 will be given the diameter, in this case about 2⅝in., which, by comparison with column 2, gives about fivefold strength.

For short shafts this examination of angular deflection is unnecessary, as, for example, in the short lengths between two gear wheels, for here the value of δ will be small enough in any case. With longer shafts, and in all special constructions, it is important to consider the angular deflection and keep in within the given limit.

For shafting of cast iron the same table may be used by taking double the values for P R, or for $\frac{N}{n}$.

For steel shafts, whose modulus of resistance is ⅘ greater than wrought iron, the diameters in both cases may be taken as $\sqrt[3]{0{\cdot}6}$—that is, 0·84 times that of correspondingly loaded wrought-iron shafts.

Shafting which is subjected to sudden and violent shocks, as in rolling mills, etc., must be made much stronger than the preceding formulæ require, and these must be classed with the special cases which occur in every branch of construction.

Example 1.—A crane chain carrying a load of 5940lb. is operated by a drum of 7·3in. radius, measured to the centre of the chain; required the diameter of the shaft to resist the torsion thus brought upon it. Here P R = 43,362, which by reference to column 2 gives a diameter between 3 and 3½in., say 3⅜in. This would require to be somewhat increased for bending stress, for which see § 150.

Example 2.—A turbine delivers 92H.P. to a wrought-iron shaft, making 114 revolutions per minute, and of a length = 8½ft. In this case $\frac{N}{n}$ = 0·807, which, by column 2 in the table, would require about 3½in. diameter. If the deflection is not to exceed 0·075° per foot, we have, in column 4, a value of $\frac{N}{n}$ = 0·803, which gives a diameter of 4½in., and with this diameter the angle of torsion would be 8·5 × 0·075 = 0·65°. A similar case in practice has a shaft diameter of 5⅛in., which gives a still smaller angular deflection.

§ 145.

WROUGHT-IRON SHAFTING.

d	For Strength.		For Stiffness (Torsional).	
	P R	$\frac{N}{n}$	P R	$\frac{N}{n}$
1	1,327	0·021	123	0·0019
1½	2,591	0·052	301	0·0048
1½	4,479	0·071	625	0·0099
1⅝	7,112	0·114	1,157	0·0183
2	10,616	0·168	1,975	0·0313
2¼	15,115	0·239	3,164	0·0502
2½	20,739	0·329	4,822	0·0765
2⅝	27,600	0·438	7,061	0·1120
3	35,830	0·568	10,000	0·1587
3½	56,890	0·902	18,520	0·2941
4	84,930	1·347	31,600	0·5015
4½	120,900	1·919	50,620	0·8032
5	165,800	2·632	77,160	1·2240
5½	220,880	3·503	111,000	1·7920
6	286,600	4·548	160,000	2·5390
6½	364,400	5·784	220,300	3·4960
7	455,200	7·222	296,400	4·7040
7½	559,800	8·883	390,600	6·2000
8	679,400	10·780	505,700	8·0240
8½	815,000	12·930	644,400	10·2300
9	967,400	15·350	810,000	12·8600
9½	1,138,000	18·050	982,700	15·6000
10	1,327,000	21·050	1,230,000	19·5900
10½	1,536,000	24·380	1,501,000	23·8100
11	1,766,000	28·020	1,808 000	28·6800
11½	2,018,000	32·020	2,159,000	34·2600
12	2,293,000	36·390	2,560,000	40·6200

§ 146.

LINE SHAFTING.

In the previous discussion we have assumed that the bending forces upon shafting might be neglected. As a matter of fact this is rarely the case, only occurring when the turning moments are those due to a simple force couple. Nearly all the shafting used for power transmission is subjected to bending stresses due to belt pull, pressure of gear teeth, weight of gears and pulleys, and to take all of these into consideration would make a very complicated calculation.

In most cases ample strength will be given by taking the diameters according to the formulæ (133) or (134). As already shown, these give ample strength, so that any ordinary bending stresses are provided for. These give reduced diameters for the higher speeds, shafting for high-speed machinery running at 120, 140, or even 200 revolutions per minute.

First movers run a lower speed and are proportionally heavier, and the line shafting generally is gradually reduced in diameter in the successive ascending floors of a building. Such line shafting is only occasionally made of cast iron, when moderate power is to be transmitted.

The practice in the proportion of shaft diameters is not altogether consistent. In many cases very high stresses are permitted, as in the case of locomotives, in which stresses of 12,000 to 15,000lb. are borne by wrought-iron cranked axles; shafts of screw-propeller engines usually carry 7000 to 8500lb., while in many instances the stresses upon line shafting are very light, when the high rotative speed is taken into consideration. This is particularly the case in England, the shafting running at higher speeds with a proportional reduction in diameter. The greatest difficulty to be encountered lies in the fact that the forces are rarely given with sufficient accuracy, the so-called "nominal" horse-power which a shaft is supposed to transmit bearing no definite relation to the actual power. In most cases, however, the use of the formulæ above given for stiffness, with a slight increase for very long shafts, will give satisfactory results.

A few examples will serve to illustrate the manner in which the methods given may be applied, and the remarks which have been made should be borne in mind in connection with the application.

Example 1.—The screw shaft of a large war ship is driven by two cylinders, each exerting a total pressure of 176,000lb., on cranks of 21·75in. radius, situated at right angles to each other. The shaft is of wrought iron, and between the crank shaft and the propeller it is 72ft. long, by 15in. diameter. Calculating this for strength by formula (131), we have:—

$$PR = 2\sqrt{0{\cdot}5} \times 176{,}000 \times 21{\cdot}75 = 5{,}412{,}000$$

$$d = 0{\cdot}^{\circ}\ \sqrt[3]{5{,}412{,}000} = 15{\cdot}98\text{in., say } 16\text{in.}$$

If it is desired that the torsional deflection shall not exceed 0·075° per foot of length, formula (133) must be used, giving:—

$$d = 0{\cdot}3\sqrt[4]{5{,}412{,}000} = 14{\cdot}47\text{in.}$$

This is somewhat less than the previous dimensions, and consequently the deflection will be less than 72 × 0·075 = 5·4°.

Example 2.—In the mills at Saltaire there is a cast-iron driving shaft making 92 revolutions per minute, and transmitting 300H.P., the diameter being 10in. According to formula (134) the diameter would be:—

$$d = 5{\cdot}63\sqrt[4]{\frac{300}{92}} = 7{\cdot}56\text{in.},$$

so that the actual shaft is ⅓ stronger, and the other shafts in the mill are proportionally heavy.

Example 3.—In the rolling mill at Rheinfall is a line of wrought-iron shafting 223ft. long, transmitting 120H.P. The speed is 95 revolutions, giving the ratio $\frac{N}{n} = \frac{120}{95} = 1{\cdot}263$. The diameter for strength, as given from column 3 of the table, would be about 3⅜in. The actual sizes are 3½in. in the journals and 4in. in the body. The corresponding fibre stresses are 7397lb. in the journals, and 6541lb. in the body of the shaft. According to the formula of Fairbairn, who designed the mills at Saltaire, this shaft would have been made

$$d = 7{\cdot}4\sqrt[3]{\frac{N}{n}} = 8{\cdot}00\text{in.},$$

or nearly eight times stronger than was actually used.

Example 4.—In the spinning mill at Logelbach there is a cast-iron shaft 8¼in. diameter, making 27 revolutions per minute, and transmitting 140H.P. by actual measurement. The ratio $\frac{N}{n} = \frac{140}{27} = 5{\cdot}19$.

Taking the double value in the table, since the material is cast iron, we find in column 5 that $d = 8\frac{1}{4}$. The diameter, for strength only, would be found by column 3 to be about ⅞in.

Example 5. In the same mill is a line of cast-iron shafting 84ft. long, transmitting 270H.P., and making 50 revolutions, hence $\frac{N}{n} = 5{\cdot}4$.

The journals are 6⅞in. diameter, and the body of the shaft is the section shown in Fig. 413, and its section approximates to that of a cylindrical shaft of 8¼in. diameter. For such conditions the table gives in column 3, taking double the value of $\frac{N}{n}$, we get d = 8in. The diameter 6⅞in. in the journals gives a fibre stress of about 5200lb. From the length of the shaft it is advisable to take the diameter for stiffness, which we get from the value corresponding to $2\frac{N}{n} = 10{\cdot}8$ in column 5, which gives d = 8⅝in., which is quite close to the actual dimensions.

(*To be continued.*)

Shipbuilding Notes.

On the 21st ult. Messrs. R. Craggs and Sons, Middlesbrough, launched a steel tank steamer of the following dimensions:—Length, 293ft.; breadth, 38ft. 6in.; depth moulded, 26ft. 3in. The triple-expansion engines will be supplied by the North-Eastern Marine Engineering Company Limited, Sunderland. The cylinders are 31½in., 36in., and 59in. diameter, by 36in. stroke.

The Fairfield Shipbuilding and Engineering Company Limited, Govan, launched, on the 19th ult., a steel sailing ship which they have built to the order of Messrs. Briggs Harvie and Co., Glasgow. Her dimensions are:—Length between perpendiculars, 298ft.; breadth, 44ft.; and depth, 24ft. 6in. The vessel, which will be provided with the most approved appliances, is 2350 tons gross, and of 3850 tons carrying capacity.

The Admiralty have given instructions for the building of the new first-class gunboat "Dryad" to be commenced immediately at Chatham Dockyard. She is to have a length of 250ft., with a breadth of 30ft. 6in., and a displacement of 1070 tons. Her engines are to be of 3500H.P. under forced draught, with a speed of 19 knots, and 2500H.P. under natural draught, with a speed of from 17 to 17½ knots. The armament is to be the same as that of the other gunboats building under the Naval Defence Act—namely, two 4·7in. and four 3-pounder quick-firing guns, and five torpedo tubes.

The new steel screw steamer "Woodville," built and engined by Messrs. John Readhead and Sons, South Shields, has been taken on her trial trip off the Tyne. The dimensions of the vessel are as follow:—Length, 299ft.; breadth, 40ft. 8in.; moulded depth, 21ft. 3in. The engines are of the triple-expansion type, having cylinders 23in., 37½in., and 61½in. diameter, with stroke of 39in., steam being supplied from two large steel boilers, with three patent furnaces in each. The deadweight capacity of the vessel is about 3700 tons. The engines worked admirably, and to the satisfaction of all concerned, an average speed of 11 knots per hour being obtained over the measured mile.

The Value of the Steam Jacket.

(*Continued from page* 205.)

Valve-chest Water.—At 10-40 p.m., during the trial with steam in both jackets, the drain from the high-pressure valve chest was opened, and the condensed water was collected and measured. From 10-40 p.m. to 12-10 a.m. 40lb. of water was condensed, from 12-10 to 1-30 a.m. 40lb., and from 1-30 to 5-0 a.m. 80lb. Thus 160lb. of water was condensed in 6 hours 20 minutes, equivalent to 25·26lb. per hour. During the whole of the trial without steam in either jacket, the condensed water from the valve-chest drain was collected and measured, and 41lb. was thus condensed in the 10 hours, equivalent to 4·1lb. per hour.

Pressures, etc.—The various pressure gauges were read at regular intervals throughout both of the trials. The mean barometric pressure was 30·11in. of mercury throughout the trial with steam in both jackets, and 29·52in. of mercury throughout the trial without steam in either jacket. Indicator diagrams were taken from each end of each cylinder every half-hour throughout both of the trials. There were thus taken 17 sets or 68 single indicator diagrams during the trial with steam in both jackets, and 22 sets or 88 single indicator diagrams during the trial without steam in either jacket. The following table gives the average mean effective pressure and indicated horse-power in each of the two cylinders throughout both of the trials :—

—	Mean Effective Pressure. Lb. per sq. in.		Indicated Horse-power.	
Date of Trial, 1888	22 & 23 Mar.	21 & 22 Mar.	22 & 23 Mar.	21 & 22 Mar.
Jackets, with or without steam	WITHOUT	WITH	WITHOUT	WITH
	lb.	lb.	I.H.P.	I.H.P.
High-pressure cylinder.....	29·93	24·44	94·8	82·6
Low-pressure cylr..	5·32	6·34	67·2	85·4
Total....	12·80 (reduced to low-pressure cylr.)	12·45	152·0	168·0

Temperatures.—The temperatures of the feed water, injection water, air-pump discharge, outer air, engine room, and stokehold were all observed at regular intervals throughout both experiments. The injection-water temperature remained steady at 41° F. throughout both of the trials.

The following table shows the mean temperatures obtained by calculation from these readings :—

Date of Trial 1888 Cylinder Jackets, with or without Steam	22 & 23 Mar. WITHOUT.	21 & 22 Mar. WITH.
Temperature of feed water.....F.	67·4°	75·2°
Temperature of injection water .....F.	41·0°	41·0°
Temperature of air-pump discharge water.....F.	68·7°	69·1°
Temperature of outer air .....F.	37°	44°
Temperature of engine room .....F.	68°	69°
Temperature of stokehold .....F.	72°	75°

Boilers.—Steam was supplied from three Cornish boilers, each 28ft. long and 6ft. diameter.

No. 43. Experiment on a triple-expansion engine at the Waltham Abbey pumping station of the East London Waterworks, by Mr. Henry Davey and Mr. William B. Bryan.

Engine.—The engine on which the experiment was made is a triple-expansion surface-condensing engine of the ordinary inverted direct-acting marine type, made by Messrs. T. Richardson and Sons, of Hartlepool, and was fully described and illustrated in "Engineering," August 8, 1890, pp. 158 and 162. The diameters of the cylinders are 18in., 30·5in., and 51in. respectively. The stroke of each of the three cylinders is 36in. Each piston crosshead is connected to its crank by a single connecting rod, and to a pump plunger by a pair of pump rods. There are thus three steam cylinders, three pump plungers, three connecting rods, and three pairs of pump rods. Each of the three cylinders is provided with an ordinary slide valve actuated by a separate eccentric on the crankshaft. The slide valve on the high-pressure cylinder is actuated direct by its eccentric, and is provided with a Meyer expansion valve, by means of which the speed of the engine was regulated during the experiment. The slide valves on the intermediate and low-pressure cylinders are actuated through variable-expansion links, but the positions of these remained unchanged throughout the experiment.

The crankshaft is placed above the pumps, and the cranks rotate in the sequence—high, low, intermediate. The fly-wheel is placed towards one end of the crankshaft, and beyond there is fixed a crank actuating a pair of well pumps by means of rocking quadrants. The bodies and both ends of all three cylinders are steam-jacketed, the cylinders forming liners in the body jackets. Steam is supplied to these jackets through a pipe connected to the main steam pipe on the boiler side of the stop valve. The steam to the jacket enters at the top on one side and at the bottom on the opposite side, and in ordinary working the high-pressure jackets discharge directly into the boiler, while the intermediate and low-pressure jackets discharge through steam traps into the hot well. The jackets of the high-pressure cylinder receive steam at full boiler pressure, and by means of reducing valves the pressures in the jackets of the intermediate and low-pressure cylinders are maintained a little higher than the pressures in their respective steam chests. Each cylinder is therefore jacketed with steam a little above its own initial pressure.

The following are the areas of the inner surfaces of the cylinders, which are all wholly jacketed :—

Cylinder.	Area of Inner Surface. Wholly Jacketed.		
	Body.	Ends.	Total.
	sq. ft.	sq. ft.	sq. ft.
High-pressure	13·44	4·22	17·66
Intermediate.....	23·95	10·14	34·09
Low-pressure	40·05	28·37	68·42

Each of the three cylinders was provided with a Richards indicator, placed midway between the two ends and furnished with pipe connections and a three-way cock, so that a diagram from each end of the cylinder could be taken on the same paper. As a rule this is not a good arrangement; but in the present case the engine worked so slowly (only 23 revolutions per minute), and the indicator pipes were so large and so well lagged, that the diagrams may be taken as practically correct.

Details of Experiment.—The experiment consisted of two trials which were made at the Waltham Abbey pumping station of the East London Waterworks on the 6th and 7th December, 1889, by Mr. Henry Davey and Mr. William B. Bryan. They began at 11 a.m., and were continued without stoppage until 7 p.m. on each of the two days. During the trial on 6th December steam was admitted to all the jackets; whilst on 7th December no steam was allowed to pass into any of the jackets. There was thus two eight-hour trials, the first with steam in all the jackets, and the second without steam in any of the jackets; and all the other conditions remained as far as possible the same.

(*To be continued.*)

Manchester Association of Engineers.

ON Saturday, 26th ult., a meeting of the Manchester Association of Engineers was held at the Grand Hotel, Aytoun-street, Manchester, to discuss the paper read at the previous meeting by Mr. B. H. Thwaite on "The Economic Possibilities of the Generation of Electro-motive Force in the Coalfields, and its Application to Industrial Centres." Mr. Thwaite added a few remarks to his very exhaustive paper, and the discussion was opened by the chairman, Mr. Thos. Ashbury, C.E., who touched upon several points raised in the paper. He was strongly of opinion that in power-transmission plant of this kind provision should be made for simultaneously satisfying all the maximum demands for energy which could possibly be made upon the system. The scheme advanced appeared to him to be a bold one, but in the face of what had been accomplished in electrical science during recent years, it was not, he thought, to be considered impossible.

Mr. A. G. Brown criticised the paper at length. He considered that where separate machines require to be driven, electric power might in some cases result in a saving of 50 per cent., but the cost of an installation for the purpose was very great. With regard to the use of gas engines, as advocated by the author of this paper, Mr. Brown considered that this motor was not sufficiently reliable for the purpose, and in any case he advocated the use of storage cells in order to provide a reservoir of energy which might be drawn upon on emergency. Regarding the financial aspect of the question, the speaker was of opinion that the working expenses allowed by the author were altogether unreasonably small, and that one half the sum allowed would only represent a suitable salary for the manager of a central station of the kind proposed. He also considered the depreciation allowance far too small.

Mr. Saxon referred to the difficulty of heating mills, etc., if electric energy was employed in the textile industries, and also doubted if the requisite steadiness of running would be maintained.

Mr. E. G. Constantine remarked upon the need of reform in the use of fuel in large towns, and after a few further remarks by Mr. Saxon, Mr. C. N. Pickworth and others, Mr. Thwaite, in replying, said that so many points had been dealt with in the paper that it was manifestly impossible to deal with them at the moment, but that he would reply at length by correspondence. After a hearty vote of thanks had been awarded to Mr. Thwaite for his interesting and exhaustive paper, the members repaired to an adjoining room to witness an experiment made by the lecturer as to the effect of the refrangible rays of the arc light upon plant life. By the kindness of Dr. Oliver, of Kew, two specimens of the *Acacia Cophantha* were supplied to Mr. Thwaite, and these, when exposed to the arc light, were most noticeably and quickly affected, their leaves rapidly distending and opening, and the whole appearance of the plant undergoing a marked and revivifying transformation.

The Design and Construction of Stationary Engines.—XLII.

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IN the case of a compound tandem engine, the total pressure on the crankpin will be the total pressure on the high-pressure piston, added to the total pressure on the difference of area between the low and high-pressure pistons, less the back pressure on the low-pressure piston.

Example.—Suppose a tandem compound condensing engine, boiler pressure 80lb.; H.P. cylinder 22in. diameter, L.P. 38in. diameter, by 4ft. 6in. stroke, making 50 revolutions per minute, cut-off at $\frac{1}{3}$ in high-pressure cylinder. Back pressure, 4lb.

Then the total absolute pressure on high-pressure piston will= 380 × 95 = 36,100lb. Terminal pressure in high-pressure cylinder $= \frac{95 \times 18}{54} = 32$lb., which is also forward pressure on low-pressure piston, assuming there is no drop in pressure. We have, then, 754 × (32 − 4) = 21,112lb. on low-pressure piston. The total pressure on piston rod is 36,100 + 21,112 = 57,212lb.

$$\text{Then } l = \frac{18{,}050 + 21{,}112}{2} \times \frac{50}{110{,}000} = 9\text{in. long,}$$

$$\text{and } d = \sqrt[3]{\frac{57{,}212 \times 4{\cdot}5}{900}}$$

for Whitworth steel = 6·58in., say 6½in. diameter.

Suppose the above engine to be of the receiver type with cranks at right angles. The initial pressure on the L.P. piston will be about 24lb. We may assume that there is a loss of pressure between engine and boiler of 3lb. (this we might have assumed in the previous calculation), then the initial pressure on H.P. piston will be 92 − 24=68lb. Then total pressure on H.P. piston=380 × 68=31,840lb. The mean pressure on H.P. piston will be about 40lb. Then mean total load on H.P. piston will be 380 × 40=15,200lb.

We have then :—

$$l = \frac{15{,}920 + 15{,}200}{2} \times \frac{50}{110{,}000} = 7{\cdot}7\text{, say } 7\tfrac{1}{2}\text{in. long; and}$$

$$d = \frac{31{,}840 \times 3{\cdot}75}{900} \quad 5\text{in. diameter.}$$

The diameter of the L.P. pin will usually be the same, unless this cylinder is made to develop greater power than the H.P. cylinder, or drives the air pump, in which case the pin should be increased in proportion to the extra load on it. It will be interesting to compare the results given by these rules with a few examples taken from actual practice of good makers.

Example 1.—Horizontal condensing engine, having cylinder 30in. diameter by 8ft. stroke, 45 revolutions per minute, 100lb. boiler pressure; assume earliest cut-off at ½; back pressure, 5lb.; loss of pressure between boiler and engine, 5lb.; expansion coefficient for steam condensing at the temperature of saturation=0·437; area of cylinder=706·8 square inches.

By formula for bearing pressure only, and assuming 700lb. as safe load, we have :—

$$706{\cdot}8\left\{\left(115-5\right)-5\right\} = \frac{706{\cdot}8 \times 105}{700} = 106.$$

The length of such pins is usually about equal to their diameter. Then $\sqrt{106} = 10{\cdot}3$. The actual length was 11in. The diameter by the rule would therefore be :—

$$\frac{106}{11} = 9{\cdot}6\text{in.}$$

The actual diameter was 10in. Applying formula 4, the total initial pressure is 706·8 × 105=74,214lb.

The total mean pressure = 706·8 × 105 × 0·437 = 32,431.

Then let C_1 = in this case 120,000. We have then :—

$$l = \frac{74{,}214}{2} + 32{,}431 \times \frac{45}{120{,}000} - 13\text{in.}$$

By formula 3 the diameter would be :—

$$d = \sqrt[3]{\frac{74{,}214 \times 6{\cdot}5}{900}} \quad 9\text{in. nearly,}$$

giving about the same diametrical section. In a large engine like this it would be inconvenient to make the pin so long, and the necessary surface would be better obtained by shortening the pin and increasing the diameter.

(*To be continued.*)

Trade Notes.

Messrs. Neilson and Co., Glasgow, have received an order from the Midland Railway Company for ten tank engines.

Messrs. Schuckert and Co., of Nuremberg, are supplying a 200H.P. steam dynamo to the central station at Hanover.

Messrs. Siemens and Halske, of Berlin, have secured the contract for the lighting of the harbours of Galatz and Braila with electricity.

Messrs. Aveling and Porter, of Rochester, have been commissioned to supply a 15-ton steam roller for the Inverness (N.B.) Police Commissioners.

Messrs. T. Firth and Sons, Norfolk Works, Sheffield, have received an order for a quantity of axles from the Northern Railway Company of France.

Messrs. John Shaw and Co., Maryhill Ironworks, Glasgow, have secured the contract for 800 tons of cast-iron pipes for the Corporation of Calcutta.

Messrs. Morrison and Mason, Glasgow, have secured the contract for the erection of the new Rutherglen Bridge over the Clyde. The contract price is over £62,000.

Messrs. Armstrong, Mitchell and Co. have, it is reported, secured the tender for a new high-speed cruiser for the Chilian Government of about 4500 tons displacement.

Messrs. Caird and Co., of Greenock, have contracted with the Peninsular and Oriental Company to build a couple of cargo steamers, with a carrying capacity of over 7000 tons.

It is stated that the Oldbury Railway Carriage Company have secured an important order for carriages for India. The value of the order is said to be something like £10,000.

Messrs. Wm. Jessop and Sons Limited, of Sheffield, have just completed the casting of a large rudder for a Russian ironclad. It is 14ft. 6in. wide, 20ft. long, and weighs between 10 and 12 tons.

Messrs. Cowan, Sheldon and Co., Carlisle, are erecting a new 130-ton crane at Stobcross. The lifting power will be tested up to 150 tons, and when finished it will be one of the largest cranes in the kingdom.

Messrs. Stephen and Sons, Linthouse, Glasgow, have booked an order from the new Transatlantic Company for three steamers of 5000 tons each. The steel plates will be supplied by Messrs. Napier and M'Intyre, Glasgow.

The Admiralty contract for the next five years, for the supply of mooring chains and other mooring gear, has been given to Messrs. H. P. Parkes and Co., of Tipton, and another five years' contract for ordinary cables was divided between that firm and the Round Oak Ironworks Company. The value of these orders is about £80,000.

Readers of "The Mechanical World" are invited to send to the publisher of "Good Health," the new weekly paper devoted to food, drink, medicine, and sanitation, for a parcel of specimen copies, which will be sent gratis and post free, for distribution among their friends at home and abroad. Address, 391, Strand, London, or New Bridge-street, Manchester.

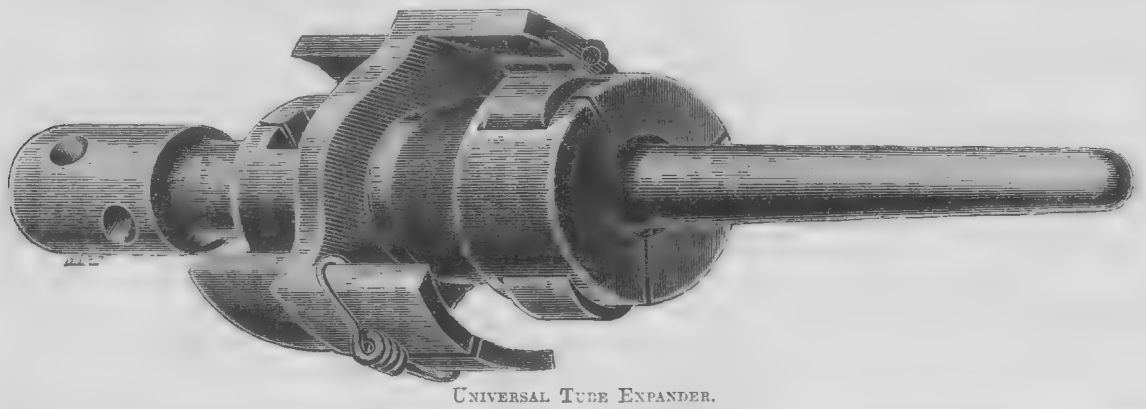
Wheel cutter in metal only. Every description of gearing. R. CHIDLAW, 43, City-road, Manchester.

Having regard to the enormous circulation of THE MECHANICAL WORLD, the Editor suggests that it is by far the best medium for the insertion of every kind of "Wanted" advertisement, and the price is only one halfpenny per word. The Editor will be glad if MECHANICAL WORLD readers will kindly bear this in mind as occasion arises.

Universal Tube Expander.

HEREWITH we give an illustration of the Universal tube expander, manufactured by Mr. J. C. Nicholson, Wear Tool Works, Sunderland.

Briefly, it may be said that the principal features of this useful tool are:—It is double-ended, the same mandril being used for either end; also the body of the expander is ½in. larger in diameter at one end than at the other, and as each end gives ½in. of expansion, it is possible to expand tubes with one tool, ranging over 1in. in diameter. Thus the No. 2 size—that most generally used—will expand all tubes between 2¾in. and 3¾in. in diameter. From the illustration it will be seen that the body of the expander is in three sections, an arrangement which admits of additional expansion and enables the operator to manipulate the rollers as required. The sections are held together by a steel spring, while the guard is made in two parts hinged together at one side and held by a spring at the other, to admit of expansion, the parts protruding being of different diameters, suitable for the sizes of each end of the sections. Three rollers are supplied for each end, and these, as well as the taper mandril and lever, are made of the best cast steel of a special quality. We may add that Mr. Nicholson has lately opened commodious premises, showrooms, etc., at 59, Side-street, Newcastle-on-Tyne, where this and other tools can be seen.



UNIVERSAL TUBE EXPANDER.

Electrical Transmission of Power for Cotton Mills.

(*Concluded from page* 214.)

MOTORS have been applied to calico-printing machines with great success. The absence of heat, small amount of space, little momentum of the revolving parts, and the control by which the machine can be uniformly moved in either direction at any desired speed, are all advantages of the highest practical value.

Other classes of work require that the motor should revolve at as uniform a speed as can be obtained by a water wheel, or better if possible. Motors will revolve at a constant speed if furnished with a current of uniform pressure. A compound generator will produce a current at a uniform pressure with variations in the load or quantity of current required by the motors; and it will also to some extent compensate for slight variations in the speed at which it is driven. Therefore it may be said that the speed of an electric motor may be more uniform than that of the water wheel or engine from which it derives the power which it gives forth.

A variation in lights is not a direct measure of variation in a dynamo, because a change of one per cent. in the pressure of the electricity in an incandescent lighting system would cause a variation of several per cent. in the amount of light from the incandescent lamps.

The class of service for the distribution of power throughout a mill as a substitute for belt or rope transmission has not been tried in cotton mills, but there are many cases where it has been tried in machine shops, and yielded excellent results. The amount of power required in cotton mills is so much greater than in machine shops that the subdivision should be to a smaller unit than a whole room in a large mill. I am convinced that such a distribution of power is mechanically feasible; but will it pay to do so when motors and generators each cost nearly or quite 40dols. per horse-power, or, including wire and foundations, over 100dols. for every horse-power transmitted?

Another class of applications consists in distributing the electricity from a central station in a mill yard to the various buildings. The most complete plant of this kind is at the Edison Works at Schenectady, where 1500H.P. is electrically distributed to numerous shops situated at various places on a tract some twenty acres in extent. The Thomson-Houston Works at Lynn have an extensive electrical distribution of power in their present works, and will have a larger power plant when their new works are completed.

At the Cumberland Mills in Maine, 260H.P. is transmitted over a mile by the Mather electric system, and motors are used to drive paper machinery, giving from poorly-governed water wheels a sufficiently steady motion for calenders; but the compensation by the compound wound generators is not sufficient to remove the effect of all the variations of speed in the water wheels from appearing in the motors, and these motors cannot run Fourdrinier paper machines, although motors in these mills, deriving their power originally from a steam engine, perform satisfactory work in driving paper machines. At these same mills an installation of motors is being constructed for the transmission of from 1200 to 2000H.P. for a distance of seven miles. As water wheels give sufficiently uniform speed for looms, and as motors do give a more uniform speed, there is but little question as to their mechanical suitability for such work.

The third class of applications for electric motors is in connection with long-distance transmission of power for the purpose of bringing the energy of a water privilege to a locality more convenient for manufacturing. The problems of short-distance transmission already considered are as different from those involved in the transmission for a long distance as river navigation differs from that on the ocean; and the extent to which these long-distance problems have been mastered was shown by the transmission of 300H.P. 109 miles, through No. 6 wire, at the Frankfort Exhibition in Germany last year. There are power transmissions in California for mining machinery for long distances, some of them being 27 miles, but I am not aware that any such great distance has been applied for driving textile machinery.

The electric lighting and power used in Hartford, Conn., are derived in part from a water power at Tariffville, 10 miles away and some 300H.P. is transmitted along the wire that distance and thence distributed to customers around the city.

The Nonotuck Silk Company are supplying to their mills at Leeds and Haydenville power transmitted by electricity from a dam in a rocky gorge in the river about a third of a mile from one mill, and a mile and three quarters from the other. The installation is not cited as being on a large scale, but because it contains many ingenious features in the manner in which the motors are applied as an auxiliary and a regulator to the water wheels. The fall of 30ft. is situated between steep banks where it would not be developed under ordinary conditions, because the spot is unsuitable for the location of a mill. There are two water wheels in use, one of 90H.P. driving dynamos which furnish 950 incandescent lamps on an alternating system at the mills. The other, 130H.P. water wheel, drives one Thomson-Houston generator of 85H.P. and another of 30H.P., the pressure of the current being the same as that used on trolley street cars. At the mills one-third of a mile distant is one motor of 45H.P., two of 20H.P., and one of 10H.P., all supplied by electricity from the 85H.P. generator.

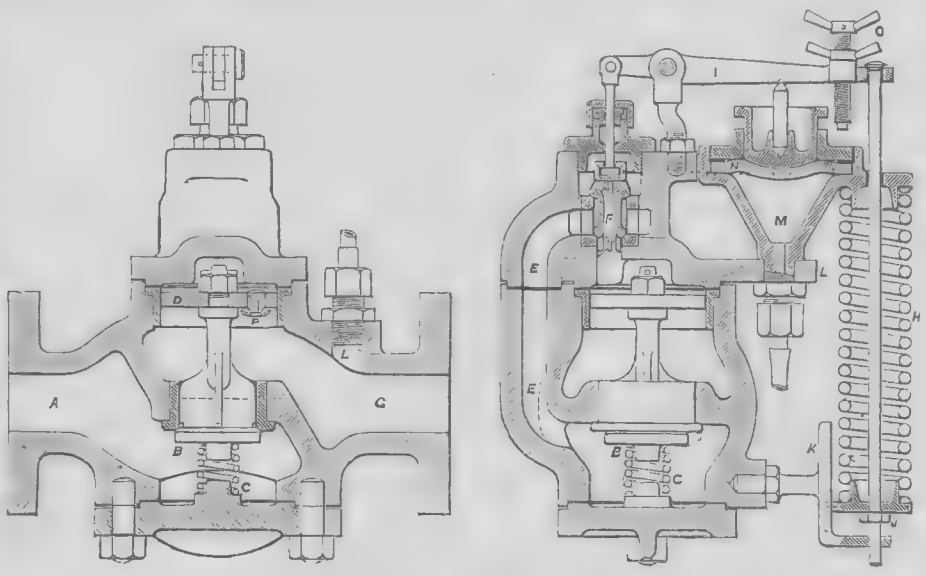
The 45H.P. motor belts upon the main shaft, which is driven by two water wheels having a capacity of 100H.P. under a 12½ft. fall. The water wheels are run at full gate without any regulator, but the motor serves as a regulator running at uniform speed and furnishing the remainder of the power, which has a variable range of 25H.P. When the water falls too low for the water wheels and motor to run the mill, a steam engine is belted to the main shaft, the motor and water wheels furnishing their full capacity, and under these conditions the engine regulates the speed of the whole. It is an important precaution to set the governor on the engine for a speed slightly greater than its proportion to the motor and water wheels, so that it will lead and also prevent the motor from tending to do more than its proper capacity. The other three motors are used to drive the machinery in an adjoining mill building, and they are connected directly to the shafting, one in each room. The 50H.P. generator at the power station operates a 45H.P. motor in the mill at Haydenville, a mile and three-quarters distant. The arrangement of motor, turbines, and engine, is the same as at the lower factory, but placed in a more compact manner. Arrangements are being made for an increase of this electric plant.

There are several places in New England where the power of waterfalls is being applied through electrical apparatus to machinery at a distance, and there are numerous extensive enterprises of this nature under construction. The electric transmission of power under any practicable conditions of constant or variable speed at a loss not exceeding 20 per cent. has been shown to be entirely practicable, and the open question in regard to all of these devices, whatever may be their purpose, is but the question of cost.

It was my privilege at a meeting of this association held ten years ago to present a paper on the subject of "Electric Lighting of Mills." The applications of electrical illumination have grown during these ten years to such an extent that the daily manufacture of incandescent lamps in this country is now three times the whole number of incandescent lamps then in use in the United States, and I believe that there is no reason to question why there will not be in this decade a comparable increase in the applications of electricity to the transmission of power.

Automatic Pressure-reducing Valve.

ALTHOUGH a large number of steam pressure-reducing valves are in use, it is a fact that many of these are notoriously defective and unreliable, allowing steam to pass of a very much greater pressure than that for which they are adjusted. The makers of the valve shown herewith claim to have completely overcome this great difficulty, and to have produced a reducing apparatus which, no matter how the boiler pressure fluctuates, does not allow the reduced pressure to vary from the intended degree. Referring to the illustration, A is the inlet or high-pressure side, and B is the valve kept up to its seating by a phosphor-bronze spring C. The valve is connected to a balancing and loose piston D, fitting quite slack, so that there is no risk of jamming. On steam being admitted the valve B closes, but a small passage E allows a certain amount of steam to pass up to the small double-beat valve F, which, it will be observed, is larger at the top than at the bottom, so that it will always rise with pressure underneath. A small amount of steam pressure is sufficient to raise this small double-beat valve, and to admit steam on to the piston D, which has a very large area, being 1in. larger in diameter than the valve. As soon as the steam reaches the large piston D it overcomes the phosphor-bronze spring C, thus opening the valve and admitting the steam at the valve as well as over the piston, making a balanced valve. Any steam passing through the loose piston D only finds its way into the low-pressure side G. The spring H, as will be noticed, is connected to the lever I, and thence to the double-beat valve F. The spring has a nut so that the pressure required can be regulated by the scale. The low-pressure side is tapped, as shown at L, and a syphon and coil (not shown) leads to the cup M, which is kept continually full of water, so that steam cannot escape at the Dermatine flexible valve N. Above the flexible valve is a loose dish, working with a spindle against the lever I. If the spring is set, say, for 80lb., as soon as this is exceeded in the low-pressure side it overcomes or compresses the spring, and the lever I rises, closing the double-beat valve F. No steam then reaches the large loose piston, and the steam naturally closes the valve. As soon as the pressure is reduced on the low side, the little beat valve closes, and steam passes through to the low-pressure side, as already described. The traversing surface of the working parts is exceedingly short, so that there is little wear and tear. By means of the thumb screw and nut O, the lever can be raised and the beat valve closed securely, so that the valve can be used as a by-pass. The small valve P allows steam to pass through to balance the large piston, and the steam then passes through the valve when being used as a by-pass from the donkey boiler. It is claimed that this apparatus will not allow steam to accumulate, while it is easily regulated to suit any pressure required; also that it is very compact and is easily taken to pieces and fixed. Further particulars may be had from the makers, Messrs. William Reid and Co., 112, Fenchurch-street, London.



AUTOMATIC PRESSURE-REDUCING VALVE.

Society of Engineers.

THE next ordinary meeting of this society will be held at the Town Hall, Westminster, on Monday, the 5th December, when a paper will be read on "The Shortlands and Nunhead Railway," by Mr. A. G. Drury, of which the following is a synopsis:—Introduction; object of the line; location, route taken and physical features; earthworks; earthwork slips, with description of methods adopted for their repair; description of works; examples of road bridges over the line; reasons for the adoption of the various types of bridges; description of larger bridges over other railways crossed; viaduct through Catford and retaining wall; permanent way; short description of stations on the line; cost of the works; conclusion.

BORINGS for salt which have been carried on at Windsor, Ontario, by the Pacific Railway Company since July last have had a successful result, a bed of rock-salt at least 30ft. thick having been reached.

Boring and Turning Mills.*

THE majority of engineers know only too well the great advances [illegible] building of machine tools. [illegible] necessity, must be made to keep [illegible] with the times, for it behoves us to [illegible] every source of expenditure, with the result that often the skilled mechanic finds to his dismay that a reduction of his weekly pay is mooted; while often the most essential problem is left unsolved — viz., good machine tools. When one has travelled a great deal, and worked in some of the finest shops of the country, he has then the opportunity to become thoroughly acquainted with divers machine tools; but there is one that is seldom seen in English shops, and which is worthy of note—viz., the vertical boring mill. Now, to the American this machine is his favourite, and finds its place in all shops here. Why? Because of its many advantages over the lathe, which are as follow:—

(1.) Its work-table is supported by a bearing near the perimeter or outer edge, as well as at its centre, whereas in the lathe the faceplate, as well as the weight of the work, overhangs the bearing or journal, which is usually of small dimensions; the consequence is, that when turning work of even moderate diameters it is subjected to a deal of spring, deflection, and vibration.

(2.) It is more easy to set the work on the table of the mill than on the lathe faceplate or chuck, because the former lies flat, so that the work can readily be placed upon it, set up true by wedges or other packing, and also marked by scribing block on the table. Then, again, in setting the work central and truing up, there is no liability or risk (while slacking off the bolts to wedge up) of the work moving at other points, and so becoming unset. Again, it does not require to be held while setting; its own weight, in nearly all cases, is sufficient to hold it, whereas in the lathe it requires to be held and steadied by cramps, plates, or other holding devices, which, often after careful setting, the first swing is sufficient to displace.

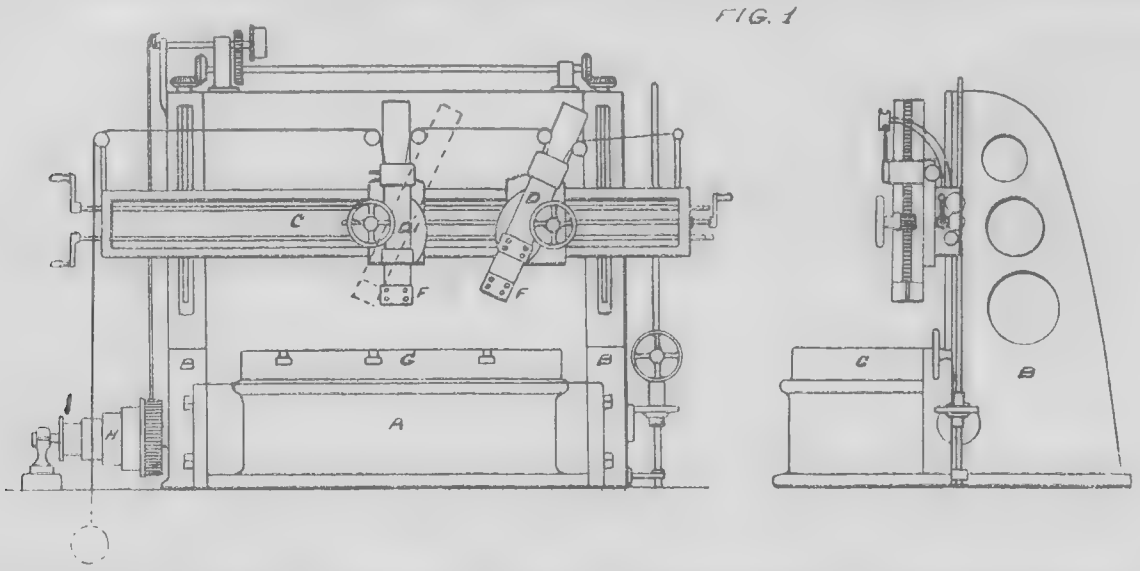
(3.) It can readily be made to carry two slide rests, which are exceptionally easy to operate, while both tools are in full view of the operator.

The outline sketch Fig. 1 will give an idea of the machine in question, and being so widely used here, it has been brought to a fair state of perfection by its American builders; but it is still open to improvements, and at the same time should be made to suit the English market. Several things, such as a good platform for the operator to stand on, to be used only when the work requires it, should be added. By this we can at once see that it is a subject for intelligent workmen to study. Referring to Fig. 1, which we will take, for example, to be an 8ft. boring mill: this should allow a full swing of 97in. diameter, and be able to take in work 48in. high when the cross-rail is raised. Boring bars should have 32in. traverse; speed about 160 revolutions per minute. A is the machine frame, on the sides of which are bolted the standards B. Except in the case of large mills, they should be made to move back, and so allow work to be taken in of larger diameter. To this is attached the crossrail C, with adjustable slides. This can be raised and lowered by hand or power, on a similar plan to that adopted in our own standard planer. It is fitted usually with two saddles, as shown by D, D¹, through which slide the tool-holders, moved by a pinion engaging with a rack which is fastened on the bar. The saddles are right and left, so that they may be brought close together; at the same time they should be made to work radially by worm, as shown by dotted lines D¹. The advantage of this can be readily seen when, for example, one is boring and turning wheels, sheaves, etc. One holder can be used for boring the hole, while the other holds the tool for turning the rim.

The tool holders F F should be counterbalanced by placing a series of small sheaves on the holders, attaching a small wire rope or chain to one end of the cross-rail, passing it round the sheaves and down at the other side, having at its end a weight, as shown. G is the table on which the work is set, similar to the faceplate of a lathe; it may be supported by an annular ring under the outer edge, with a footstep at its centre, or preferably a curve bearing, as shown by Fig. 2. The former can be arranged as Fig. 5, so that when heavy work is on the table the spindle is released, allowing the whole weight to rest on the outer bearing. Thus it can be adjusted so that it is as rigid and steady as a planer, at the same time retaining the precision of a good and accurate lathe; but when used for light work, it can be carried on the spindle centre by lifting the footstep.

The table is driven from the cone, which is back-geared, driving a small pinion (preferably of steel) engaging with a bevel spur gear ring under the outer edge of the table. With this gear there is no tendency to lift.

FIG. 1



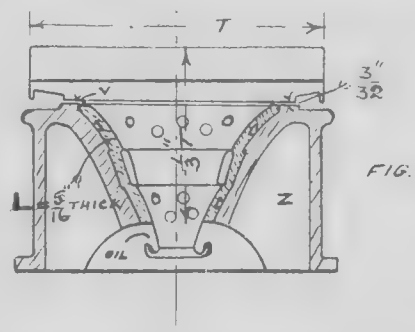


FIG. 2.

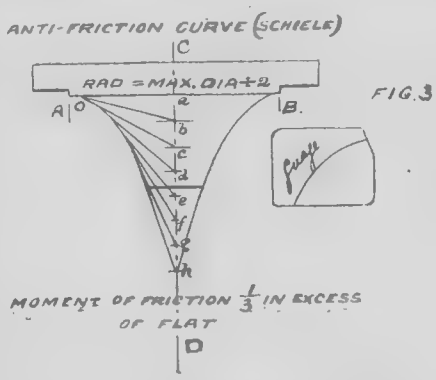


FIG. 3

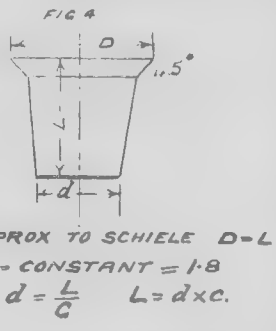


FIG 4

To the underside of the table should be cast a spigot, the curve of which should be male part of which the spigot should be turned and accurately fitted.

Fig. 2 shows a section of this bearing with the table T in its place. L is a liner of Babbitt's metal run in as follows:—Set the table perfectly true, so that there remains $\frac{3}{32}$in. of space between the table and the bed Z, as shown at V. Run into this space the Babbitt metal, which should be sufficient to allow the liner to be not less than $\frac{5}{16}$in. thick. To keep the liner in place, a number of projections should be cast on Z, as shown. When the metal is set, lift out the table, take off all imperfections on the liner, and fit the table perfectly true to its bearing by scraping. Use very thin red lead as a marker, as with this there is little liability of error. It is necessary to fit in after casting, on account of any unequal contraction taking place in the casting of the liner. With this bearing the depth should be one-third the diameter of the table, and should the bearing surface be too great, it can be taken out, as shown in sketch, the bottom curve being similar to the top, but of less diameter. The pressure on these bearings should not exceed 400lb. per square inch.

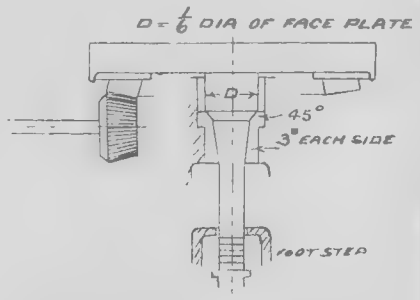
This may be an expensive bearing to make compared with some, but none are so efficient. It can be made in a somewhat modified form, which is an approximation to the Schiele curve, as shown by Figs. 4 and 5, with which a footstep can be used, the chief dimensions for which are given. These, although appearing to be mere rules of thumb, have nevertheless been arrived at by experiment and experience, and the arrangement shown has been used by many of the leading American makers.

The next point is the gearing. This should be capable of taking a range of feed from $\frac{1}{32}$in. to $\frac{9}{16}$in., and so strong that the tool would break first should the operator allow his tools to become worn down or be suddenly applied. Hence the pinions should be of cast steel; also the gearing must be well fitted, so that it would have no tendency to lift the table.

Boring bars and tools should be strong and rigid, preferably octagon or square in section, with the corners taken off and fitted with caps, so that any wear may be taken up. They should also be arranged so that one bar may be brought exactly central with the spindle or centre of the table at the same time, and be able to be set over at any angle.

Keeping these points in view, one is able to design a reliable machine, and one that need never be idle. ATLAS, U.S.A.

FIG 5.



Having given this general explanation, some of the most important and vital parts of the machine may now be noticed in detail. The foremost of these is the bearing for the table, and it is, therefore, necessary to go into this thoroughly. Fig. 2 shows a bearing in section, which the writer has found to be the best, and is that made to Schiele's curve, which has been termed the "anti-friction pivot curve."

The friction on this is greater than the moment for an equally smooth flat of the same radius, but it has an advantage,

* This article has been awarded a prize in our Monthly Competition.

Belfast Mechanical and Engineering Association.

ON Friday, the 25th ult., at the ordinary meeting of the above association, a paper on "Spinning Rollers" was read by the vice-president (Mr. James Gamble). The chair was taken at eight o'clock by the president (Mr. Jerdan Nichols). In the course of his paper Mr. Gamble traced the difficulties which had been encountered in rollers for flax spinning, and laid much stress on the recent inventions of Mr. J. Erskine and of Messrs. Combe, Barbour and Combe Limited. An interesting discussion followed. Drawings of modern dry and wet spinning frames were shown, and sample brass rollers, both cast and shrunk on, were also placed on view.

Steam Pipes.

A MEETING of the Institute of Marine Engineers was held on Monday, the 14th ult., at the premises of the Institute, 58, Romford-road, Stratford, when Mr. W. J. Nowers Brett read a paper entitled "Steam Pipes: Their Material, Workmanship and Arrangement." Mr. J. W. Craig occupied the chair, and there was a large attendance.

Mr. Brett, in the course of his paper, said that the subject of steam pipes had, during recent years, assumed great importance in the engineering world, and looking at it in the light of some recent experience in explosions and fractures, he thought it well worth their earnest consideration and discussion. The higher pressures of the present development of the marine engine had caused a certain amount of suspicion to rest upon the brazed-work copper pipe, and accidents, attended in some cases with lamentable loss of life and injury, seemed to confirm engineers in their opinions as to the uncertainty of the ability of these pipes to stand the more severe test now imposed upon them. In the old-fashioned two-cylinder compound engines the brazed copper pipe did its work very well, and there was no reason why it should not be used for very high pressures with perfect safety. Although brazed main steam pipes were looked upon with mistrust, the seam of a good copper pipe properly made was as strong as the rest of the material; and for many reasons these pipes were almost exclusively used in marine practice. Consequently this method of manufacturing pipes claimed their primary, and he might also add their earnest attention, because it was likely to be generally used for some time. The greatest danger attending the brazing of a seam was the liability to burn any part of the material, causing the formation of a flaw or crack where it was originally sound, or to partly burn the bevelled edges and so make the seam unsafe, and therefore this operation required all the care of a skilful and trustworthy man. A great deal depended upon the way the edges were bevelled. It was customary in some places, in the interest of cheapness, to bevel the outside edge and not the inside edge of the seam. It was almost unnecessary to say that this method should be deprecated, because it was clear that the thick edge would work into the part overlapping it, and so render the pipe liable to tear or crack in a line parallel

with the seam. Both edges should be bevelled, but if made long and thin they were more liable to burn; the bevels of medium length always made the most satisfactory seam. In the best practice the bevels for straight lengths of pipe should be formed on the edges by machine planing, and then, and only then, were true and level surfaces obtained, and he believed this method was really the cheaper of the two. Mr. Brett then gave particulars of a steam-pipe explosion which took place on the "City of Lincoln" (s.), as serving to show the development of flaws in a copper pipe. This instance belonged, he said, to the category of which the steam pipe of the "Elbe" was a prominent illustration, and included a number of others more fortunate in the matter of loss of life. The failure on the "City of Lincoln" was in the form of a crack through the solid copper of a length of 8in. along the edge of the brazed seam. The failure, according to the report, was partly due to the presence of water, but mainly to the fact that the pipe was dangerously weak by reason of old flaws. The pipe was patched, and when tested to a pressure of 140lb. per square inch the steam began to leak towards the flange, and when 200lb. was reached it leaked freely. On examination the seam was found to be defective for about two-thirds of its length, and the pipe was replaced by one of solid drawn copper. It was very possible that the exploded pipe of the "City of Lincoln" was not tested when new, because the pipe was in such a state that if a hydraulic pressure of double the working steam pressure had been applied the defective condition of the pipe would, no doubt, have been made known. Perhaps the most thorough test for a brazed pipe was the customary one of that eminent shipbuilding firm, Messrs. Denny and Co. —viz.: The pipes were tested at the coppersmith's to double the working pressure, the brazed seams were examined by hammering along the whole length of the seam and by using a magnifying glass to detect any flaws that might have occurred; and, further, the pipes, when jointed up in their places, were again tested, from the engine-room stop valve to boiler stop valve, to double the working pressure. This was a very substantial test, and should be adopted by all engine builders for new work, and by superintendent engineers periodically. In many cases where brazed pipes had failed they had been replaced by those of solid drawn copper, but experience had shown that though the solid drawn pipe was a very great advance towards the perfect steam pipe, there was yet further room for improvement in quality and greater care in their manufacture. In his own opinion, the solid drawn pipe had been excelled by the copper depositing process invented by the Messrs. Elmore. He had seen specimens of their manufacture that appeared to be the ideal of copper steam pipes realised. In section they were perfectly true and of uniform thickness all round, and could be manufactured to any diameter required in practice. They were guaranteed to reach a tensile breaking load of 20 tons per square inch, with proportional elongation, either lengthwise or circumferentially. After describing the process of manufacture, Mr. Brett went on to say that from a financial aspect the copper deposited pipe bore, apparently, a very favourable comparison with its rivals, its market price being the same as the solid drawn pipe. But judging from the fact that it took a very long time to form the deposit, he was inclined to think that if the patents were to be profitably worked, the selling price must be raised. After referring to the bending of copper pipes and the working of copper tee-pieces and pieces with a number of branches, the lecturer remarked that to save the trouble and expense of flanges the socket joint was sometimes used, but he strongly recommended that in any case particular attention should be paid to the running of the brass solder, as it rarely ran the depth of the socket; no joint of this description should be used in the vicinity of a bend. The brazed flange had been almost as troublesome as the brazed seam, and had contributed its quota to the number of defective steam pipes. The ordinary method of fixing the flange—by bevelling the end of the pipe into the countersunk side of the flange and then brazing—was sufficient if the flange was a very stout one; but very often the flange was thin, often without a bevel and having very little bearing. Making the flange with a boss gave a good bearing surface for brazing; but there was a medium between having too much and too little. Various devices had been resorted to, to secure a comparative amount of safety in case of an explosion of a brazed seamless copper steam pipe in the marine-engine room and stokehold, which otherwise presented few facilities for the hurried escape of those employed there. These devices had been adopted to reduce or prevent the escape of steam. Of the former, perhaps one of the best was by binding the pipes with copper or steel wire, which did not reduce the flexibility of the pipe, and would, if the pipe gave way, prevent the fracture from being of serious dimensions, and would, therefore, allow time to close the stop valve. It was this, he presumed, that suggested to Mr. Peter Denny the idea of strengthening pipes by encircling them with hoops placed at suitable distances apart along their length, and binding them as tightly as possible. Great care should be taken in fixing the hoops, as not only could the iron be strained, but the pipe as well, and more especially so if the hoops were made red-hot for twisting. It occurred to him that a more commendable method of strengthening a brazed pipe was by winding round it a flat spiral copper strip at a given pitch, and either brazing it to the pipe along the line of the longitudinal seam when the seam was brazed, or separately, or tinning and soldering on the spiral in convenient lengths; and this, he thought, would give more satisfactory results than hoops or wire-winding. The failure of copper pipes often repeated naturally suggested to some engineers the desirability of dispensing with copper altogether as the material, and using another. Wrought iron and cast iron had been occasionally used since the earliest days of marine engineering, but they had few expressed opinions upon their behaviour. Recently, wrought-iron and steel lap-welded pipes had been fitted to high-pressure marine engines with apparently satisfactory results, the greatest possible care having been taken to provide an ample number of expansion glands to remove all likely strains due to structural conditions. Manufacturers were now directing their attention to improvements in the production of solid drawn steel tubes, with a view to supersede copper, and, having this before them, and the fact that solid drawn or lap-welded steel or iron pipes were considered likely to be eventually universally used, it would be well to note the working conditions of a steel or iron pipe. Referring to the fitting and general arrangement of steam pipes, Mr. Brett said that sharp bends must be avoided if at all possible, and other arrangements substituted, and in the general design as few ordinary bends as possible introduced. All ranges of piping must be efficiently drained, and drain pipes fitted wherever condensed steam or water from priming was likely to collect. Water in a steam pipe acted like a hammer, and all pipes were subject to its stress more or less. It had been the primary cause of several explosions—some quite recently. Water hammer action was a grave danger and might be the cause of a perfectly sound pipe failing. In the fitting of steam pipes he must strongly denounce the practice of drawing pipes up to their places with bolts, if they did not fit. The resulting vibration acting upon a pipe or pipes held in a strained position was sufficient to damage even the best brazed seam or flange. More attention should be paid to the fixing of engines and boilers, and to the balancing of the working parts of engines. An important point in favour of copper as a material for steam pipes was that it could, from its nature, take up the greatest number of small unknown strains that must occur in ranges of pipes, better than any other material, and thereby give less trouble with the joints. Its most serious defect was its loss of strength with every increment of temperature, but the day was distant when they would have to increase the margin of safety for compensation. So far, copper pipes had rarely, if ever, burst in the material apart from the seam or flange, but he would suggest a greater margin of safety than that now generally used, and this was becoming more recognised in new work. Regarding brazing, he reiterated the remark that, if properly done, it would be equal to the strength of the copper itself, and, as it was likely to be used, although so often denounced, he hoped, as a safeguard, to see the introduction of a brass solder of great strength and comparatively low running temperature. By this means they could get a more reliable brazed pipe, because the possibility of burning the material would be more remote.

(To be continued.)

MESSRS. SCOTT AND CO. launched at Greenock, on the 23rd ult., a steel screw steamer for the Ocean Steamship Company, Liverpool. The dimensions are:—Length, 354ft.; breadth, 42ft. 6in.; depth (moulded), 30ft.; and of 3600 tons gross. The builders will supply triple-expansion engines of 2000H.P. indicated.

Metal-cutting Tools.

The Finishing Cutter. — The finishing cutter, if accurate work be required, should be very carefully fitted into the bar slot, so as to always occupy the same relative position when keyed into place. In form it is much like the gib of a connecting-rod stub-end, except that it is proportionately much wider. It should be shouldered down on both ends to a depth about equal to its thickness, and overlap the bar in the direction of the feed—the necessary flats at each end of the slots being provided for the purpose. On the accuracy of the fitting of the cutter shoulders to these flats will depend the accuracy of size of the hole the cutter will make, and as this is usually required to be standard, to be followed by the hand reamer, the importance of careful fitting may be appreciated. After this is accomplished the key should be driven snugly home and the bar placed in the lathe for turning the cutter. The leading edge and ends only require to be thus finished, and the diameter should be made only enough larger than the finished size to allow for finishing out the tool marks by hand. Before taking the cutter out of the slot after turning, one end should be marked, as also the bar at end of slot to which it belongs, as it must, of course, always be inserted in the same way.

After hardening (the temper may be from full hardness to dark straw colour) the cutter should be carefully cleared on the ends by means of an oilstone, as very little clearance is required or allowable, as these ends act as the guide and determine the diameter of the cut. The edge clearance will be governed by the material of the work and the pitch offered, but it must not be excessive, or the tool will work badly. The amount of stock left for this finishing cut must be very little, as its function is properly that of smoothing and sizing only, and the resultant hole should be as clean and smooth as after the seamer, and perfectly round and straight. Having so large an amount of guiding surface, the cutter may be used a long time without the size decreasing appreciably. When the facilities are available, it is best to file or turn the cutter somewhat above size, and finish by grinding with a fine wheel after tempering. The end clearance, however, should always be made by hand as described.

Two forms of cutter are used for squaring or finishing the ends of holes. The first, the roughing cutter, must be made long enough to reach as far out from centre as it is desired to finish, and still leave a full bearing in the slot. It must fit tightly sidewise, and be keyed as tightly as possible to admit of its being tapped out with the hammer at each revolution, which is the method of feeding. There should be a backward projecting point, so that the body will be clear of the cut; the shape of point, its clearance, etc., like that of the roughing cutter for inside work. The body should not be hardened, as it is unnecessary, and would cause risk of breakage from the transverse strain. The temper of point may be straw colour, but if made too hard there is danger of its breaking on account of the rather violent means employed in feeding.

The finishing cutter is made double-ended to give two opposite working edges. It should be tightly fitted and keyed in the slot and squared off in the lathe either by turning before or grinding after hardening. The face should be perfectly flat, no lip or groove being necessary, and unless the edge clearance be very slight it will be sure to chatter badly, the result being a surface beautifully decorated with radial corrugations, more ornamental than desirable. A very slow speed is necessary, and the feed steady and firm, but without forcing. The temper may be quite hard for short cutters, but much softer for those of greater reach. The edge should be kept keen by the use of oilstone, not only with a view to clean, smooth cutting, but also because if dull it is apt to refuse to cut until the feed pressure is so heavy as to cause the tool to dig in and possibly spoil the work when it does take hold. After the necessary amount of stock is cut down the cutter should be allowed to revolve a few times without feeding, for the purpose of completing the finish, which, if the cutter be in proper order, will be as bright and smooth as if polished with emery.

Among the special tools used with this bar may be mentioned those for chambering or recessing in the bore, external flange turning, internal and external screw thread cutting, chamfering, etc., *ad infinitum*. On every large work, particularly for bores whose length is too great for the use of the heavy overhung bar first described, the self-feeding bar is used. For work in the lathe, it is placed on centres, and should therefore be centred deep and true to the proper angle, to give sufficient bearing to ensure against its changing by wear during a long cut, the result of which would be a taper bore. Owing to its large diameter the bar may be (and generally is) made of cast iron, though wrought iron and mild steel are frequently used. A deep spline with semi-circular bottom is planed from end to end, and in this is placed the feed screw. The latter, usually square threaded, is cut its entire length and carried by a bearing at each end of the bar. Its position in the spline should be low enough to ensure its clearing the circle of periphery of the bar. At the driven end of the bar the feed screw should be held in position longitudinally by means of a collar on the inside of bearing and a nut and washer on the outside. At the other end is keyed the feed wheel—usually what is known as the star feed.

The Star Feed.—It is a wheel minus the periphery, and the arms act in the manner of a ratchet by striking a stationary stop at each revolution of the bar, which indexes it around until the motion carries the arm clear until the next revolution, when the next arm comes into play. This, of course, turns the screw part of a revolution, according to the number of arms in the star wheel, and the duration of interval during which the latter is held by the stop. The variations of feed are made by adjusting the position of the stop nearer or farther from the centre, so as to increase or decrease the duration of contact with the arm, and where a greater difference is required by changing the wheel for one having a greater or less number of arms, the greater number, of course, giving the slower feed. It is usual to have a sufficient number of these wheels to give all necessary changes of feed, though one set will generally be sufficient for a number of bars. This method of feeding has one objectionable feature in that it is intermittent and forces the cutter along the full pitch in a very small portion of the revolution, instead of being continuous, as is the correct and usual manner of feeding on other kinds of work. Its chief recommendation is its simplicity and cheapness.

A continuous feed may be very easily made by means of a stationary internal gear, set concentric with the axis of the bar and a system of change gears for different pitches of feed, to be used on the screw. This, of course, necessitates the use of a slotted arm for carrying an idle or intermediate gear to compensate for the changes of diameter of the screw gear. A very simple means of carrying the stationary gear is by making it with a clamp hub bored to fit the dead spindle of the lathe. This ensures perfect concentricity, and dispenses with any necessity for adjustment, besides holding it rigidly in position. The cutters are carried by a circular head, made to slide on the bar, and having a key to prevent its turning, the latter sometimes having an independent spline on the opposite side of the bar from the feed screw, but generally using that in which the screw is seated. The head also has a long nut through which the screw passes, and by means of which it is fed along the bar. The length of bearing in the head should be sufficient to prevent any possibility of its becoming jammed on the bar from the application of the motion on one side only. Also, the fitting must be so close as to prevent any possibility of lost motion, which would affect the character of the work.

In different positions in the head are a number of seats for the various cutters used in the numerous operations for which the bar is adapted. It is usual, where considerable stock is to be removed, to use two or more cutters at the one time, each one being set the proper amount deeper than the one preceding it, so that all will have the same depth of cut. Where the core is fairly true this plan is a very good one, and particularly where three equally spaced cutters are used, as they have a steadying effect on the bar, besides feeding the three cuts at one pass. If the core be badly out of centre, however, so that most of the cut comes on one side of the bore, it is much better to use but the one cutter, as it enables the entire stiffness of the bar to be applied to resisting the springing tendency of the one-sided cut, and by making three passes instead of but one, the eccentricity is decreased a given amount each time, and will generally effect the truing up by the time it is necessary to start the finishing cut.

The roughing cutters may be of any desired form of body—that best adapted to the holding device in head being usually selected. The cutting edges, however, should conform to the general requirements of those already described—modified, of course, to suit the kind of material upon which they are to operate. The finishing cutters should also be similar, as to cutting edges, to the double-end cutter

referred to in connection with the slotted bar. In starting the finishing cut, the size must be calipered at a point where the strain of the entire cut comes on the bar—that is, it will not answer to caliper where the cut starts in, after making one or more attempts, as the cut being so much lighter at this point there will be correspondingly less spring to the bar, and consequently it will bore larger than after the full cut has been reached. The proper allowance to make for this point is entirely a matter of judgment, dependent on the skill of the workman. It is important that the cut be not allowed to run farther than is absolutely necessary to enable the size to be measured, as if several false starts are thus made the effect on the uniformity of the finished bore will be very perceptible. Of course, for engine or other cylinders in which the heads are made of larger diameter, a suitable counterbore is provided, the size of which does not need to be so exact as that of the bore itself, and this will always give ample space in which to start the finishing cut for the latter.

It is of the utmost importance that, after once starting, the cut should be kept running at a uniform speed of revolution and feed until entirely through the bore, as upon its continuity will depend the uniformity of size necessary in this class of work. Any stoppage or change in speed will invariably result in an offset at the point where it occurs, no matter how stiff or accurately fitted the bar and its appurtenances may be. This feature, of course, applies to boring with any form of bar or tool, and the importance of providing against its occurrence may be appreciated from the fact that where the inequality of size is once established it becomes a matter of extreme difficulty to correct it by subsequent manipulation, unless a sufficiently heavy cut be run the entire length of bore, thereby increasing the size beyond that originally intended.

(To be continued.)

Metal Trade Memoranda.

The Lanarkshire Steel Company are making extensive additions to their works at Flemington.

After another long period of idleness work has again been resumed at the Clydebridge Steel Works.

The Terni Steelworks, Italy, commenced operations on the 28th ult. at the works of Tardy and Benech, in Savona, which were recently acquired by them.

Several additional mills in the Swansea, Morriston, and Llanelly districts have resumed work after some months' cessation, during which 8000 operatives were idle.

The Consett Iron Company have resolved to blow out another of their blast-furnaces in consequence of the present depression in trade prospects, this making three out of the seven furnaces out of blast.

Several iron and steel mills in America have announced a reduction of wages and a decreased output. The Illinois Steel Company, in South Chicago, with 3500 men, will close on December 15, probably for two months; the Carnegie mills, at Beaver Falls, announce that wages will be reduced 20 per cent. for various classes of labour.

A valuable discovery is said to have recently been made near Mitchell River, Grafton district, at a mount called Walker's Pinch, New South Wales. The find is believed to be well situated for economical working; abundance of excellent timber and permanent water are in the locality, while seventeen miles distant is a public wharf.

Since July the Rudolphshutte at Teplitz has had in operation a new method of manufacturing thin sheets, which is intended to effect a considerable alteration in the processes hitherto adopted. According to the new method, which is the idea of Mr. K. Wittgenstein, the chairman of the administrative council, a plate 1½mm. (about ⅛in.) in thickness and 50m. (about 164ft.) in length can be made direct from an ingot 1ft. thick. The product can be used either as a ready article or in connection with the production of thinner sorts of sheets.

The Metal Market.

PRICES CURRENT.

LONDON, Nov. 28.

COPPER opened firm at 5s. advance, cash sales being made at £47 17s. 6d. and three months at £47 8s. 6d.; and although at one time there seemed more disposition to sell, three months declined to £48 5s. The firmness with which near positions were held caused a rally, and prices moved upwards to the close, £48 10s. being paid for three months, and on the kero £48 12s. 6d. to £48 11s. 3d., while a few days short of a month made £48 5s. Cash ranged from £47 17s. 6d. to £48. The advance is due to decreased supplies and stiffening prices in America, combined with speculators covering and considerable outside support, the market closing firm and 10s. better on the day. Sales, 1000 tons. Settlement price, £48. English tough, £51 10s.; best selected, £52 to £52 10s.; strong sheets, £59.

TIN showed a weakening tendency during early operations, owing to rumours of the repeal of the American import duty by the old Senate next session, and five weeks and three months were sold at £93 15s. Later on the former position was let pass at £93 12s. 6d., but under manipulation cash recovered to £94, which was also paid in the afternoon for a week's prompt. The close is quiet, with three months showing a loss of 5s. from Friday. Sales, 170 tons. Settlement price, £94. English ingots, £97 to £97 10s.

PIG IRON advanced to 41s 8d. buyers Scotch cash at the opening, due to the receipt of higher prices from Glasgow, but there was much divergence between buyers' and sellers' views, and business accordingly was checked. Final rates are 2½d. to 3d. up for Scotch, while Middlesbrough is unchanged and hematite 3d. lower. Settlement prices:—Scotch, 41s. 8d.; Middlesbrough, 37s.; hematite, 46s. 3d.

TINPLATES quiet and unchanged. I.C. cokes, f.o.b. London, 12s. 9d. to 13s; Liverpool, 12s. 3d. to 12s. 6d.; Swansea, 11s. 9d. to 12s.

LEAD has shown no variation. Spanish, £10 to £10 1s. 3d. sellers; English, £10 5s.

SPELTER has ruled quiet and in buyers' favour, closing 2s. 6d. down. December shipment, virgin brands, £18 17s 6d. sellers. Silesian specials are offered at £19 5s.

ZINC SHEETS.—Silesian ordinary are quiet at £22 to £22 2s. 6d. ex ship; Belgian quiet but steady; V.M. brands, ex ship, £22 5s.; f.o.b. Antwerp, £22.

OFFICIAL CLOSING QUOTATIONS.

	£	s.	d.	£	s.	d.
COPPER—						
G. M. B.—Cash	48	0	0	48	7	6
" Three months	48	10	0	48	17	6
English tough		—			—	
Best selected		—			—	
Strong sheets		—			—	
TIN—						
Fine foreign—Cash	94	0	0	94	10	0
" " Three months	93	15	0	94	5	0
Australian—Cash	94	10	0	95	0	0
PIG IRON—					s.	d.
Scotch warrants—Cash					41	8½
" One month					41	11
Middlesbrough—Cash					37	0
" One month					—	
Hematite—Cash					46	3
" One month					—	

Official Gazette.

Partnership Dissolved.

A. R. PHIPPS and A. R. DAWSON, under the style of Rashleigh, Phipps and Dawson, Berners-street, W., Shaftesbury-avenue, W.C., and Stanhope-street, W., and Bournemouth, and formerly Gray's-inn-road, W.C., electrical engineers and contractors.

THE BANKRUPTCY ACTS, 1883 AND 1890.

Receiving Order.

WILLIAM EDWARD HEAVENS, trading as W. Heavens and Co., Hindon-street and Newstreet, Victoria Station, S.W., and Fentiman-road, Clapham, brassfounder.

Winding-up Order.

PIDOTS IRON, SILVER, AND FERRO BRONZE SYNDICATE LIMITED, Chancery-lane, London.

New Companies.

SCARBOROUGH ELECTRIC SUPPLY COMPANY LIMITED.—This company was registered on the 17th ult., with a capital of £50,000 in 5000 shares of £10 each, to carry on the business of electrical engineers and contractors, and of undertakers for the supply of electricity for lighting, transmission of power and other purposes, whether public or private; to promote, support, and obtain any Acts, provisional orders, licences, and other authorities necessary or desirable for carrying out any of the objects of the company. The number of directors is not to be less than three, nor more than nine; qualification, £500; remuneration, such sum as the company in general meeting may from time to time determine. Registered by Messrs. E F. Leadbitter and Paterson, 144, Leadenhall-street, E.C.

TEMPERED STEEL-BAR HORSESHOE SYNDICATE LIMITED.—This company was registered on the 18th ult., with a capital of £10,000, divided into 10,000 shares of £1 each, to adopt and carry into effect, with or without modification, a certain specified agreement, providing for the sale of an invention for improvements in connection with horseshoes; to develop, improve, and bring into public use, in the United Kingdom, and elsewhere, the said invention, and to render the same profitable by granting licences, or otherwise; and to carry on, in the United Kingdom, and elsewhere, the business of manufacturing, selling, and dealing in horseshoes, any material, machinery, apparatus, appliances, articles, and things required for, in connection with, or incidental to, such manufacture, selling, or dealing.

Letters to the Editor.

*** *We do not hold ourselves responsible for opinions expressed by correspondents.*

*** *The name and address of the writer (not necessarily for publication) must in all cases accompany letters intended for insertion, or containing queries.*

*** *Letters intended for publication in the current week's issue must reach our Manchester Office not later than by the first post on the Tuesday preceding the date of publication.*

SUGAR-MAKING MACHINERY.

To the Editor of THE MECHANICAL WORLD.

SIR,—The "Writer of the Articles" on the above subject is perhaps not aware that Messrs. Duncan Stewart and Co. Limited, London-road Ironworks, Glasgow, are the makers of patent sugar mills with a hydraulic-pressure cylinder on each bearing—*i.e.*, six cylinders on a three-roller mill,—and from illustrations I have seen of them the pressure is controlled by an accumulator, and it is said to be a very great success, as the pressure remains constant; and, as will be seen, the rollers having this constant elastic pressure, small cane will be crushed as well as large. Whereas, with the ordinary set screws and plates, with feed and discharge rollers set apart, say $\frac{5}{16}$ on feed side and $\frac{3}{16}$ on discharge, small cane is allowed to pass through practically untouched; and from tests made it has been proved that the hydraulic-pressure mill extracts a greater quantity of juice than the fixed rollers. Therefore, as to the question of pressure on the bearings, the above-named firm, I am sure, would be only too pleased to give the necessary information if the "Writer of the Articles" were to ask them. One grand claim the hydraulic pressure has, is that there is no chance of a cheek or a roller neck being broken, and that is something.

Glasgow, Nov. 28. THOS. HILL.

HINTS TO YOUNG DRAUGHTSMEN.

To the Editor of THE MECHANICAL WORLD.

SIR,—The article on the above subject in your current number would lead one to think that the writer was interested in the sale of drawing instruments. And it is certainly misleading to youths who contemplate entering a drawing office.

I think most draughtsmen will agree in the opinion that the *first* instruments for a beginner to buy would be a bow pencil and a bow pen, which the writer of the article says should be added afterwards.

The prices of the various instruments quoted are also very high, and useful articles—perhaps equal for wear to the more expensive ones—may be had for from 20 to 25 per cent. less, or even still cheaper.

Otherwise I think the article is good, and contains much useful information.

Might I add that it is a great mistake to have only *small* set squares. Large squares, say 12in. and upwards, save a vast amount of work, especially on large-scale drawings.

14, *Meadowbank-street*, J. NICHOLS,
Belfast, Nov. 21.

MILL-HOIST ROPES.

To the Editor of THE MECHANICAL WORLD.

SIR,—If the hoist at Birstal was of the ordinary cage and balance-weight construction, with the top or grooved pulley shaft, power driven by worm or spur gearing, the pulleys must be grooved V-shape, so as to give the amount of friction on the rope in the grooves to lift the whole load for which the hoist is designed by the makers. The steel-rope makers are quite right, because clip pulleys are required for wire-rope drives. V grooves are practically sudden death to wire ropes, and Messrs. Thomas Aimers and Sons, engineers, Galashiels, Scotland, have an improved wood-lined grooved pulley, just for the protection of steel and wire ropes, which were first applied to all the hoists at the erection of the Forth Bridge. The life of a $\frac{7}{8}$ diameter rope, previous to the adoption of the wood-lined pulleys, was from five to six weeks; but with the wood, ropes put on in September, 1887, were as good as ever at the completion of the bridge in March, 1889; and from the quantity of these pulleys being made by the above firm, it is clearly shown that the users of wire ropes have counted the cost of renewal and found a remedy. THOS. HILL.

Glasgow, Nov. 28.

Miscellaneous Items.

It is proposed to establish an electric tramway on the overhead-conductor system at Coventry.

Four new express locomotives have just been turned out of the Glasgow and South-Western Railway Works at Kilmarnock.

The Ottoman Government proposes to connect the Island of Crete with Tripolis, in Barbary, by means of a submarine cable.

A promising seam of anthracite coal has been struck at Hede, in the south of Sweden, in a locality where coals have never previously been found.

An observatory is proposed to be erected at Niagara Falls of the height of 250ft. It is to be of steel, and four big columns are to constitute the framework of the structure.

Herr Ernst Odenius, Gothenburg, has obtained a patent for a substance invented by him named "insulating cement." It is intended for the insulation of boilers and tubes, is fireproof, and adheres without any binding material.

The inauguration of electric light in Glasgow is expected early in 1893. The principal streets will be lit up meantime by 106 lamps, the sum annually to be paid to the Corporation by its Lighting Committee for each lamp being £20.

In the ensuing Session of Parliament a Bill is to be introduced with the object of seeking powers for the construction of an underground electric railway, starting at a point in close proximity to Clapham Junction, and passing thence, *via* South Kensington, to a point near the Great Western Railway Company's terminus at Paddington.

An invention of Mr. D. Williams, of Aberdare, for the lighting of trains by electricity has been provisionally patented. The inventor claims that great efficiency can be obtained, and that the cost of lighting will be greatly minimised, as the motive power will be furnished from the revolving axles of the carriage wheels, batteries being fixed in each carriage.

The death is announced, on the 16th ult., of Mr. St. John G. Lysaght, a director of Messrs. John Lysaght Limited, Wolverhampton. Mr. Lysaght had spent several years in Australia, and more recently had been to Buenos Ayres in connection with the business of the company. He returned home only a few months ago; but shortly after his return he was attacked by typhoid fever.

Fog signals are now almost all made at Birmingham. They consist of three tin cases one within another, the smallest of them containing a charge of gunpowder, with three percussion caps placed on three little iron nipples. The object of having three cases is that the innermost one may be kept perfectly dry. They are all three closed by a plentiful application of white lead, and no fog signal is considered to be good for anything if it will not stand immersion in water for four-and-twenty hours. They cost about 9s a gross.

Aluminium horseshoes are said to have been tried with remarkably successful results in the Russian Army. According to a note translated by Capt. E. Lambart from the "Invalide Russe," a few horses in the Finland Dragoons were first chosen and shod with one aluminium shoe and three iron shoes each, the former being on the fore foot in some cases and on the hind in others. The experiments lasted six weeks, and showed that the aluminium shoes lasted longer and preserved the foot better than the iron ones. No aluminium shoes broke, and they were used over again for re-shoeing. The horses, moreover, were worked over hard and very stony ground. The most important fact of all is that aluminium horseshoes are only one-third to one-fourth the weight of iron shoes. Their cost is admittedly greater; but, on the other hand, very little charcoal is required in shoeing, there is no loss in weight, and the value of the old metal is the same as that of fresh.

It is generally known that all silver coin used by British mints and all silver goods stamped at British assay offices are not made of pure silver, but of an alloy. It is, perhaps, not so generally known that that alloy consists of 925 parts by weight of silver and 75 parts by weight of copper. Silver of this composition is what is known as standard or sterling silver, which the law requires shall contain 11oz. 2dwt. of pure silver per troy pound, the remaining 18dwt. being the copper or other alloying material. Recently, an interesting application of an alloy of silver, cadmium, and zinc has been introduced in practice in silver plating by the London Metallurgical Company, of Turnmill-street, London, the alloy being deposited electrically upon the article which is to be coated with the precious metal. This alloy, although more costly than the ordinary alloy of silver and copper, is said to work well and to show greater resistance to abrasion than the latter, and to be less readily tarnished.

Prize Competition.

WE OFFER FOUR GUINEAS MONTHLY IN PRIZES FOR THE BEST ORIGINAL ARTICLES SENT IN ON ANY MECHANICAL, ENGINEERING OR ELECTRICAL SUBJECT.

IN ORDER THAT MANAGERS, DRAUGHTSMEN, FOREMEN, AND WORKMEN WHO HAVE HAD NO PRACTICE IN WRITING MAY NOT HESITATE TO SEND IN COMPETITIONS, IT IS TO BE UNDERSTOOD THAT ALL ARTICLES WILL BE FULLY EDITED AND CORRECTED, AND JUDGED OF SOLELY ON THEIR MERITS AS ORIGINAL CONTRIBUTIONS FROM A PRACTICAL POINT OF VIEW. THE OBJECT OF THE COMPETITION IS TO INDUCE PRACTICAL MEN TO COME FORWARD AND GIVE THE RESULTS OF THEIR EXPERIENCE.

CONDITIONS.

Competitions for our Monthly Prizes must be sent so as to arrive at the Manchester Offices of THE MECHANICAL WORLD, New Bridge-street, not later than the last Tuesday in each month. Articles arriving after that time will be placed in the following month's competition.

Written competitions must be on one side of the paper only. The contributions must be original, and relate to matters connected with Engineering, Mechanism or Electricity.

The Proprietors of THE MECHANICAL WORLD reserve the right to publish any competition, whether it gains a prize or not.

The competitions may be accompanied by diagrams' sketches or drawings.

Competitors should write the words "Prize Competition" on the envelopes.

Competitors are not confined to one, but may send any number of competitions.

The correct name and address of the sender *must* be distinctly written upon every competition, not necessarily for publication. Competitions can appear under a *nom de plume*.

☞ We cannot undertake to be responsible for any MSS. sent to us, though when stamps are enclosed for the purpose we will endeavour to return rejected contributions.

Queries.

☞ Readers are invited to avail themselves of this section for practical information on questions relating to Mechanical Engineering and the Scientific Industries.

☞ Queries and Replies should arrive at the Manchester Office not later than by the first post on the Tuesday preceding the date of publication.

IRON MIXTURE.—Can any reader supply a mixture for steam hammer heads (chilled)?—TYRO.

ECCENTRIC WHEELS.—Will any reader of THE MECHANICAL WORLD inform me how to set out a pair of eccentric wheels correctly?—J. S. P.

SPEED OF DRIVE CHAIN.—Can any reader give me any particulars as to the safe speed at which Ewart's patent chain may be run?—SECOND MOTION.

CONVERTING GAS ENGINES.—Will any reader kindly inform me how to convert a Crossley's gas engine, 15H.P., slide-valve type, to a tube firing type?—FITTER.

SWEDISH BESSEMER STEEL.—Can any reader inform me how Swedish Bessemer steel is made, and also give highest amount of carbon it contains?—FORGEMAN.

BLUE PRINTING.—Can any reader kindly inform me what the necessary mixture for *extra rapid* ferro-prussiate sensitising fluid is made from, and the quantities?—FOUNDRY.

TWIST DRILL CUTTERS.—Can any reader give me a method of getting the correct thickness and shape of cutter for any diameter of twist drill, straight lip? A drawing will greatly oblige.—J. M. F.

BOILER FOR MODEL ENGINE.—Will some reader kindly give me size of boiler for engine, horizontal, ½in. bore, 1in. stroke, engine to run at least 2 hours at each operation, boiler to be vertical?—AMATEUR.

MILLING MACHINE WHEELS.—Can any reader give me the number of wheels that should accompany a milling machine, and the number of teeth both in the smallest and largest wheels; also whether they rise by two teeth or four?—TOOLS.

FRICTION.—Could any reader tell me the difference of friction between a roller with journals of cast iron 15in. diameter working in a half bush 18in. long, and a roller with journals of steel 9in. diameter, working in a half bush 18in. long, each roller to be 30 tons.—BUSH.

PRESSED PAPER.—I shall be obliged if any reader can furnish me with names of firms in England or abroad who press paper for making trays, wheels, teeth, etc., and the widening circle of articles now made of compressed paper or pulp.—A CONSTANT READER.

TRIPLE-EXPANSION ENGINE CYLINDERS.—Will any reader show me how to find the diameters of the H.P. and M.P. cylinders, from the following data:—Diameter of L.P. cylinder, 8sin.; stroke, 5ft.; revolutions, 73; boiler pressure, 180lb.; 4500I.H.P.; cut-off in H.P. cylinder, 0·6 stroke.—W. G.

HARDENING AND TEMPERING.—Can any reader inform me how to harden and temper a number of straight steel wires 13 gauge and 16in. long? I have tried several ways, but I cannot keep them straight. I may say that I have hardened them in oil, and one at a time.—BLACKSMITH.

TUBE MANDRELS.—Can any reader inform me the best way to steady while turning, and also to lap when turned, a mandrel ⅛in. ×7ft. long, to be lapped with $\frac{1}{1000}$ of taper in the whole length? I should also like to know the price per foot for the same.—TURNER.

SEA-GOING ENGINEERS.—(1.) What are the qualifications and experience necessary to become third engineer on an ocean-going steamer, passenger or merchant service? and (2) Whether it is necessary to serve in a marine engineering shop previous to going out?—MARINE.

LOSSES IN STEEL FURNACES.—Could any reader kindly inform me the average per cent. of actual loss, and the average per cent. of skull, in the charge of a Siemens open-hearth steel furnace working charges of from 30 to 40 tons? And also the percentage of loss in heating slabs and ingots in the Siemens regenerative gas furnace?—J. R. R.

Replies.

☞ Owing to the constant increase in our correspondence, we regret that we have no alternative but to announce that we cannot reply by post to Queries even when stamped envelopes are sent.

☞ Queries and Replies must in all cases be accompanied by the names and addresses of the writers, as no notice will be taken of anonymous communications.

MECHANIC.—A query respecting this subject has already appeared.

WATER METER.—The first volume of Greenwood's "Metallurgy" would suit you.

WOOD.—Particulars can be obtained from Mr. F. Pitman, 23, Aubrey-road, Withington.

GAS BURNER.—Messrs. Thos. Stott and Co., Charing Cross, London, are makers of gas burners.

INQUIRER.—Consult Hasluck's "Model Engineer's Handybook" (2s.). It may be had from our office.

FITTER (Wigan).—The safe load in tons = $7d^2$, d, being the diameter in inches of the iron of which the chain is formed.

OVAL.—Such an instrument as you require was fully described in our issue for January 21, 1888. It is called the Bennett geometric compasses.

G. P.—We do not think you will succeed in getting your lubricator to work satisfactorily with such a long pipe connection as shown. Try lubricating the steam passing through the regulator.

STEEL.—The address of the publishers of the "Age of Steel," is Equitable Buildings, St. Louis, Mo, U.S.A. The "Iron Age," Reade-street, New York. Messrs. Jones, Burton and Co., 19, Castle-street, Liverpool, will supply you with particulars respecting spiegeleisen.

G. HAYWOOD.—Accumulators occupy space, are subject to deterioration, and cause a loss of efficiency; but the extent of this loss need not be great. Your other queries would be cheerfully answered by any firm of electrical engineers—Messrs. Blakey, Emmott and Co., of Halifax, for example.

E. G.—We will endeavour to reply to you in our next issue.

GRANITE.—Messrs. Trier Bros., 19, Great George-street, Westminster, London, do the work you require.

J. TINLEY.—We are obliged for your letter re Lloyd's rules. It appears that these were revised in April, 1892.

J. ELLIS.—We think the speed was 48 revolutions. We cannot give the clearance, but should assume 3 per cent.

J. SMITH.—(1.) Yes, if the fire is hot enough. (2.) Messrs. J. Davis and Sons, All Saints' Works, Derby, will supply you.

E. T. NICHOLSON.—It is not always our fault that the articles do not appear regularly. We will endeavour to act upon your suggestions.

JAMES WRIGHT.—We cannot always attend to queries immediately they are received. A Bunsen cell will do charge the machine with.

R. CAMERON.—We do not know of any work giving instructions for making an injector. If you consult Hasluck's "Model Engineer's Handybook," price 2s., published by Crosby Lockwood and Son, it may help you. An article on "Small Vertical Boilers" appeared in THE MECHANICAL WORLD on April 19, 1889.

STUDENT.—So far as we can see, you have stumbled over the theory of loss of power due to the crank. This has long been exploded. It would take a large amount of space to deal fully with the questions raised in your letter, and we should strongly advise you to read Goodeve's "Principles of Mechanics" and "Elements of Mechanism." (6s. each.)

ANXIOUS TO LEARN.—The following will be useful for removing stains from marble: Common soda, 2 parts; pumice stone (pulverised), 1; finely powdered chalk, 1. Pass through a fine sieve, and mix with water. Rub all over the marble until the stains are removed. Then wash with soap and water. To restere gilt frames, rub with a sponge moistened in turpentine.

CASTINGS.—Can any reader inform me how to secure clean castings which have wrought-iron pieces "cast in."?—L. U.—*A.*—The usual way is to groove the bar of wrought iron or jag it with a chisel for the steel to hold on to, and then trust to luck. In 99 cases out of 100 this is quite enough.—WATER METER.

LOCOMOTIVE AXLE BOX.—When a locomotive is pulling a heavy train up an incline, on which side of the axle box is there the greatest pressure—after or forward?—J. M. (Mexico).—*A.*—On the forward side of the axle box of the driving wheel axles, of course, as a certain portion of the train's weight pulls the engine back.—WATER METER.

WINDMILL.—I want to erect a small windmill to grind corn, cut chaff, etc., for stock on a farm, and shall be obliged if someone will advise me how to make it. What is the best kind of mill—that made on the American plan, a wheel with slats, on the principle of the venetian blind, or the old arm and sail pattern? What length of arms and sail should I require to produce 2 or 3H.P., as the case may be? Shall be glad of any information, drawings, or plans.—RUSTIC.—*A.*—S. Shipway, Swindon, would like to correspond with you.

Latest Inventions.

APPLICATIONS FOR LETTERS PATENT.

When Patents have been "communicated," the name of the communicating party is printed in italics.

Where complete specification accompanies application, an asterisk is suffixed.

14th November, 1892.

20,541 EVAPORATIVE CONDENSERS. J Whyte and others.

20,542 TOOTHED GEARING. T Humpage and H I Jacques.

20,545 RAILWAY CHAIRS. B Taylor and J F Macdonald.

20,550 ROTARY ENGINES or MOTORS. G W Rothery.

20,552 RAILWAY or TRAM SLEEPER CHAIR. G Guite and G Mills.

20,560 COMBINED TURNING and BORING LATHE. J H Evans.

20,569 FURNACES for STEAM BOILERS. J Neate.

20,575 METALLIC PACKING for PISTON RODS. S Schnack.

20,579 APPARATUS for FEEDING and DISCHARGING WATER from STEAM GENERATORS. D B Morison.

20,581 STEAM BOILER FLUES. J B Bradshaw.

20,586 RULE WITH PARALLEL and OTHER MOTIONS. F Steflitschek.

20,587 APPARATUS for CRUSHING and DISCHARGING CLINKERS. P Bony.

20,588 PERCUSSIVE ROCK DRILLS. G S Corlett.

20,589 CORK-CUTTING MACHINES. J Cuypers and A Bailly.

20,591 LOCKING NUTS. F Mottershall.

20,595 EVAPORATING or CONCENTRATING APPARATUS. F W Scott and others.

20,598 ELECTRIC ACCUMULATORS. C Theryc and A Oblasser.

15th November, 1892.

20,605 SECURING TUBES of STEAM BOILERS in TUBE PLATES to PREVENT THEM BECOMING OVERHEATED. J Phillips.

20,606 ELECTRIC ARC LAMPS.* C A Day. (*The Higham Electric Company*, United States.)

20,609 TELEPHONE CIRCUITS. G L Anders and W Kottgen.

20,611 GOVERNING ELECTRIC MOTORS.* B J B Mills. (*R Lundell*, United States.)

20,619 TUBE EXPANDERS. W T Eades.

20,632 VENTILATING APPARATUS for STEAMSHIPS. J Howden.

20,635 PIPE JOINTS or COUPLINGS. J Vevers and G S Fitt.

20,643 HARDENING and TEMPERING STEEL WIRE. H E Hodgson and W Bottomley.

20,660 UTILISING the HEAT TAKEN UP by the WATER EMPLOYED for COOLING the CYLINDERS of GAS and OIL MOTORS. J E Weyman and G W H Ellis.

20,665 WORM GEAR.* J F Welch.

20,670 TELEPHONE CIRCUITS. Sir C S Forbes, Bart.

20,672 ROLLING STOCK of RAILWAYS and TRAMWAYS. R L McLaren.

20,673 APPARATUS for WORKING RAILWAY POINTS and SIGNALS. C Hodgson.

20,676 PRODUCING or INCREASING the EFFICIENCY of MOTOR FLUIDS.* W L Saunders.

20,680 HYDRAULIC PROPULSION of VESSELS. E Davies.

20,683 GAS ENGINES. C W Pinkney.

20,687 CAR COUPLERS. M M Decker.

20,690 VALVE-OPERATING MECHANISM for GAS or WATER PIPES.* H H Lake. (*J W Ogdne*, United States.)

20,693 ELECTRIC ARC LAMPS.* F Hansen.

20,698 ELECTRIC ARC LAMP. H H Boyle.

20,700 LIGHTING TRAINS by ELECTRICITY. D Jones.

20,701 STEAM GENERATORS.* Z C Herrero.

16th November, 1892.

20,709 APPARATUS for CHARGING INCLINED GAS RETORTS. L V Vestraut and M Graham.

20,710 APPARATUS for CHARGING INCLINED GAS RETORTS. L V Vestraut.

20,712 RAILWAY SIGNALLING APPLIANCES. T H and A E Goodby.

20,715 PROCESS for TREATING SILVER and LEAD ORES. A Macdonald.

20,721 AUTOMATICALLY VARYING the LOAD and PRESSURE of GAS GOVERNORS.* W Cowan.

20,729 DYNAMO ELECTRIC MACHINES. J A Kingdon and Woodhouse and Rawson United Limited.

20,732 SAFETY HYDRAULIC BEARINGS for SUGAR-CANE MILLS. D Stewart.

20,737 EQUALISING the SPEEDS of SEPARATE PRIME MOTORS APPLICABLE to the ENGINES of TWIN or MULTIPLE-SCREW STEAMSHIPS. G W Sutcliffe.

20,745 SET SQUARES. J Mitton.

20,746 GAS PRODUCER. S Muirhead.

20,756 APPARATUS for the MANUFACTURE of SHEET-METAL TUBING. W Hillman.

20,759 APPLIANCES by MEANS of WHICH RAILWAY TRAINS may be PREVENTED from PASSING DISTANT or OTHER SIGNALS or STATIONS. S Taylor and W Naylor.

20,761 FOG SIGNALLING APPARATUS. W B Barker.

20,768 EMBOSSING SHEET METAL. R E B C R Charles and W C Fisher.

20,769 COKE FURNACES.* T Bauer.

20,770 INSTRUMENTS for MEASURING DISTANCES. W P Thompson. (*Emil Mareuse* and *the Firm of Gebruder Buchbaum* Germany.)

20,786 STEAM BOILERS. P Vallance.

20,789 APPARATUS for TRANSMITTING SOUNDS ELECTRICALLY. J G Lorrain. (*Charles Clamond*, France.)

17th November, 1892.

20,802 GAS, OIL, and SIMILAR MOTOR ENGINES. H H Andrew and A R Bellamy.

20,803 GAS, OIL, and SIMILAR MOTOR ENGINES. H H Andrew and A R Bellamy.

20,807 AUTOMATIC TAPS and VALVES. G Robinson and H James.

20,810 FEED-WATER HEATER for STEAM BOILERS. J L Major and J Henderson.

20,819 FEED-MOTION of DRILLS or BORING MACHINES for COAL. W G Liversidge.

20,824 FURNACES and BOILERS. W M Greaves.

20,826 WORKING a FORCE PUMP by MEANS of the WAVES. C Barnett.

20,828 IGNITION APPARATUS for GAS ENGINES. H Booth.

20,830 LOCK-NUT WASHERS. P A Craven.

20,836 HAND LEVER BRAKES for RAILWAY WAGONS or TRUCKS. J B King.

20,841 AUTOMATICALLY LOCKING and UNLOCKING RAILWAY CARRIAGE DOORS. W Pilling.

20,845 SHIFTING SPANNER. L Mills.

20,851 OPERATING GRABS, BOXES, or BUCKETS in GRAB CRANES. C W Maclean.

20,854 COUPLING for MINING TRUCKS.* C Koch.

20,868 HOSE COUPLINGS for HIGH-PRESSURE HYDRAULIC and STEAM MACHINERY. J Thompson.

20,869 APPARATUS for the MANUFACTURE of GAS. V B Lewes.

20,877 TUBULAR STEAM BOILERS and FURNACES. J D Ellis.

20,878 NEW MOTOR. S Rowland.

20,879 EXTRACTION of GOLD and SILVER. C King.

20,887 FIRE BOXES of STEAM BOILERS.* A S F Robinson and A C Auden.

20,899 COUPLINGS FOR RAILWAY VEHICLES. H H Lake.* (*J Hazelton*, United States.)

20,900 MANUFACTURING and DEPOSITING SPONGY LEAD for SECONDARY BATTERIES or RECEIVERS. E Bailey and J D Massey.

18th November, 1892.

20,904 STUFFING BOXES of STEAM ENGINE PUMPS. J B Burrell.

20,912 TELEPHONE APPARATUS. R J Urquhart.

20,914 REGULATOR VALVE for HYDRAULIC HOISTS. C F and A T Spencer.

20,918 RECIPROCATING PISTON ENGINES and MOTORS. H Flatters and C Nodder.

20,928 MOVABLE SPANNER. J H Wynn.

20,929 WATER GAUGES of STEAM GENERATORS. W T Dulin.

20,941 HEATING and REGULATING the SUPPLY of FEED WATER for BOILERS. P Browne and D Crawford.

20,947 APPARATUS for SUPPORTING and RETAINING RAILWAY RAILS. F W Clarke.

20,951 REGULATING the WIRES of RAILWAY SIGNALS. S T Dutton.

20,959 ELECTRIC ARC LAMP. F W and S J Suter.

20,960 GAS and OIL ENGINES. F W Crossley.

20,964 ELECTRICAL RELAYS for TELEGRAPHING to LIGHTHOUSES or VESSELS. W S Smith and W P Granville.

20,965 TUBULAR WATER BOILERS. M Gehre.

20,975 TUBE STOPPERS and AUXILIARY TUBES for STEAM BOILERS. J Parker and T Ackroyd.

20,984 LATHE and SIMILAR CHUCKS.* B Wesselmann.

20,985 DRILLS and SIMILAR TOOLS.* B Wesselmann.

20,988 WINDMILL or WIND MOTOR.* S J Rollason.

20,989 DETACHABLE ELECTRIC LIGHT BRACKET.* A W Upcraft.

19th November, 1892.

21,007 MECHANICAL STOKERS. J E L Tatham.

21,008 APPARATUS for PRODUCING ILLUMINATING GAS. J D Hall.

21,012 FUEL BALLS for ECONOMISING the USE of COAL in STEAM ENGINE FURNACES. I Vaukonowski and J Mahony.

21,021 MACHINERY for BENDING TUBES. R M McDougall.

21,028 GAS PRODUCERS. W S Sutherland.

21,031 GRINDING BALLS. The Steel Ball Manufacturing Company Ltd. and H Bridge.

21,041 ELECTROMOTORS and THEIR APPLICATION to ELECTRIC TRAM CARS and LOCOMOTIVES. J A Kingdon.

21,053 TREATMENT of COMPLEX METALLIC ORES. A Guthrie and R F Macfarlane.

21,054 TUBES for TUBULAR BOILERS. F Gross.

21,060 ROTARY BLOWERS and PUMPS.* J F A Pflaum.

21,066 TUBULAR BOILERS for HEATING PURPOSES. L White, jun., and W Y Baker, trading as the Thames Bank Iron Company.

21,075 SAFETY VALVES for STEAM BOILERS. J A Fletcher and S Fletcher.

21,084 IMPROVEMENTS in the TREATMENT of IRON. W Gilchrist.

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SMITHFIELD CLUB SHOW, 1892.

As the Smithfield Club Show, opened on the 5th inst. and closed to-day, has included many exhibits of interest to our readers, we are dealing very fully and promptly with the matter, and for this purpose we shall issue with "The Mechanical World" for Dec. 23rd

A SPECIAL SUPPLEMENT,

in which the various exhibits will be described by practical writers of acknowledged ability.

Although this SPECIAL SHOW NUMBER will entail great additional expense, the price of the Journal will still be One Penny.

Those exhibitors who have not yet arranged with us for notices are invited to do so without delay, in order that full justice may be done to their specialities by our editorial representatives.

We would point out that as the ORDINARY circulation of "The Mechanical World" now exceeds 20,000 copies weekly the value to exhibitors of descriptive notices in this special issue cannot be overrated.

FRIDAY, DECEMBER 9TH, 1892.

American Boasting and British Methods.

SEVERAL months ago a paper by Prof. John E. Sweet appeared in our highly-esteemed contemporary, the "American Machinist," entitled "American Boasting." Prof. Sweet's contribution was a mild tirade on the national infirmity of our transatlantic cousins; and although somewhat overdrawn it could not, we think, fail to produce an all-round salutary effect, although it must be admitted some of the statements made were of a nature calculated to wound the pride of the patriotic American engineer. However, his feelings will now be soothed by perusing another article on "American and British Workmen and Machinery," which lately appeared in the journal above referred to, and which we reproduce in full in another part of our impression. We believe the impartial reader of this contribution will admit that it contains much food for thought, not only for the British workman, but for the foreman and manager also. The remarks concerning American and British methods of locomotive construction are especially pertinent, and making every allowance for the "national pride" of the writer, it cannot, we think, be denied that there is much sober truth in his comments. Mr. Arthur, however, is nothing if not American, and in comparing the English with the American locomotive, appears to readily sacrifice his veracity in order to make "points" against the English engine. Thus, he remarks that the English locomotive is a "wonderful little machine for drawing railway carriages, but when you bring it to America it is practically useless for drawing railroad cars." Now we would most respectfully point out that to draw railway carriages is precisely the duty our engines are built for, and so long as they will do this at a speed and with an economy which will compare most favourably with those of any other nation, there is not much reason to find fault with them because they are not also suitable for drawing lumbering railroad cars over the rough American tracks. From Mr. Arthur's remarks that "both driver and fireman stand openly in the weather," we are inclined to think that either he saw very little of the English locomotive and nothing at all of a modern express engine, or else that he is wilfully misrepresenting facts. Of course, the protection afforded our drivers is not on a par with the very commodious cabs used in America; but then, fortunately, we have not quite the same delightful possibilities in the way of weather to contend with, although we may have more of it. In comparing the methods adopted in British workshops, Mr. Arthur appears to be more in his element, and there is indisputably much to be said for his side of the argument. For instance, it is impossible to ignore the fact that the slotting machine is far too frequently used, and that, too, in a most indiscriminate manner, in our workshops. The merits of both vertical and horizontal spindle milling machines, however, are gradually forcing them to the front here, in spite of the "obtuseness and stolidity" which characterise us as engineers, and the day is not far distant when even in this "effete country" the slotter will be relegated to its proper place in the workshop. It is impossible to deny the truth of many of Mr. Arthur's remarks upon the condition of the average British workman, although even here his tendency to exaggerate is often painfully apparent. All things considered, however, we are inclined to thank Mr. Arthur for his plain statement of the impressions he has obtained of British engineering methods and workers. To see ourselves as others see us offers an opportunity for putting our house in order, and, rightly regarded, such a contribution should teach us a useful lesson, though it can be of little use to our American cousins, if they are such wonderful people as Mr. Arthur would have us believe.

Cheap Incandescent Lamps.

MANY people have been wondering what effect the expiration in a year or two of the patents controlling incandescent lamps in this country will have upon the electric-light industry in general. Will electrical illumination, it is asked, assume a new phase and develop in a most extraordinary manner, and will the price of the incandescent lamp be reduced to such a low figure as to bring it within the meaning of the "poor man's light," as mentioned by Mr. Preece? We very much doubt it. The manufacture of glow lamps in the United Kingdom is solely in the hands of the Swan United and the Edison and Swan Electric Companies. There are no firms making the lamps on royalty, and the two companies in question have taken good care that no other than themselves should produce these lamps. In this connection the remarks made by Mr. J. S. Forbes, at a meeting of the Swan United Company, held last week, are significant. It may be mentioned that this company has a very large interest in the Edison and Swan Company, and that if they do not at present form one concern, and one only, they will soon become a combined undertaking. The Swan United Company have, moreover, a large share in the French Edison Company, which makes lamps and does installation work, whilst at the same time it has a factory in Germany, where the production of incandescent lamps is undertaken. It is in the latter country that the Swan United Company have competitors, two of whom are very formidable. In addition to these, there are several small concerns which have taken up this branch of the industry. The large companies have, however, in the words of Mr. Forbes, decided to kill the small fry, and the survival of the fittest is the order of the day in Germany. The result of the keen competition is that incandescent lamps can be purchased at very low prices—in fact, at rates ranging from just over 1s. upwards, whilst in this country we have to pay over three times that amount. The time is, however, coming when a similar state of affairs may be expected in the United Kingdom. We say may, advisedly, because the details of the manufacture of glow lamps are only known to a comparative few. The process is so distributed among the men in various departments that scarcely half-a-dozen, if so many, persons in the works know how to produce a complete lamp. The ordinary 16C.P. incandescent lamp costs about 9d. to produce, and the greater the output the less is the relative cost of manufacture. It will be evident from the somewhat discursive but, at the same time, necessary remarks, that the two companies in question are in a very strong position—so strong, indeed, that competitors would have little chance of being competitors in the fullest sense of the word. This will be readily understood. The companies control the market. It would hardly be possible to improve their lamps, whilst the position they hold would enable them not only to produce lamps at a lower rate than anyone else, but also to sell them cheaper—as, indeed, they, as Mr. Forbes remarked, intend to do. Everything, of course, depends upon the quantity of lamps made. We fail, therefore, to understand how the lapse of the lamp patents can have any material effect on the electric-lighting industry, beyond cheapening the price and increasing the output by reason of the more frequent renewals of worn-out lamps. It is not a question of the cost of a lamp which prevents anyone from adopting the electric light, since even when the lower rates come into operation the reduction in an installation of, say, 100 lamps would only mean a matter of about £5—certainly a negligible quantity to a man who could pay for such an installation. It is rather more in the maintenance of an installation—in the substitution of new lamps for those worn out—that the benefit of reduced prices will be appreciated. We can for the present only conclude that progress in electric lighting will not be greatly increased by the expiration of the Edison and Swan patents, and that we shall be very little, if any, nearer the realisation of the "poor man's light." It is to a reduction in the expenditure for actual wiring, and to the running of generating machinery at more economical loads, rather than to the prime cost for lamps, that we must look for a lower charge for electrical illumination, and therefore for the step towards the attainment of the electric light as the "poor man's light."

Calming the Sea with Oil.

IT has long been known that the act of pouring oil on rough waters has a calming effect, but it is only within recent years that any really good experiments have been made in this direction. Oil bags have, we believe, been used, but we are not aware that any purely mechanical device has been largely adopted. In this connection a few particulars concerning an apparatus termed a "wave subduer," designed by Captain C. C. Couves, will doubtless prove interesting. The "subduer" comprises an iron oil reservoir arranged above a vertical cylinder. A heavy piston working in the cylinder is attached to a tubular rod, and acting by its own weight ejects the oil on to the water. A hand wheel on the spindle rod is used to raise the piston when the cylinder is being filled with oil from the reservoir; and a supply valve, through which the oil passes from the reservoir to the cylinder, is opened and closed from the top of the same rod. The apparatus is fixed as near the bows of the ship as possible. Two small delivery pipes, fitted at the end with a conical nozzle—the aperture of which is not more than 1-16th of an inch in diameter,—pass from the lower part of the cylinder and come out at the bows (on each side) near the load line. These pipes are each fitted with a brass cock so that the oil may be expelled from one side only if desired. The cylinder is filled with oil from the reservoir by opening the supply valve between; the valve, as already mentioned, being operated from the top of the rod. The oil then runs through, the piston being raised to the top of the cylinder, by means of the hand wheel, as the oil flows in. The ascending of the piston, it may be mentioned, causes a vacuum in the cylinder, and thus facilitates the passage of the oil from the reservoir. When the cylinder has received the requisite amount of oil, the valve is closed, and the hand wheel run up to the top of the piston rod. The piston then rests on the surface of the oil, and to set the apparatus in operation it is only necessary to open one or both of the brass cocks of the delivery pipes, when the oil issues forth in a fine but steady jet several feet from the bows. When the vessel is in motion, the oil is thrown away with the broken water from the bows as she makes her way onward. It is claimed that the effect upon the water is shown at once, and particularly on those breaking seas which cause so much loss of life and damage to property. This wave subduer is a permanent fixture, and it is said to be always ready to be used. It is claimed that the apparatus cannot get out of order by ordinary use, that the only attention required is the charging with oil, which only need be done once in four hours if both jets are in use, and that the appliance only occupies a small amount of space. The subduer, which is made by Messrs. Couves and Co., of 11, the Exchange, Cardiff, is spoken highly of by different pilots and shipmasters who have had it in use for some little time.

THE largest and longest stone bridge in the world is over an arm of the China Sea. It is five miles long, and contains 300 arches, each 70ft. high.

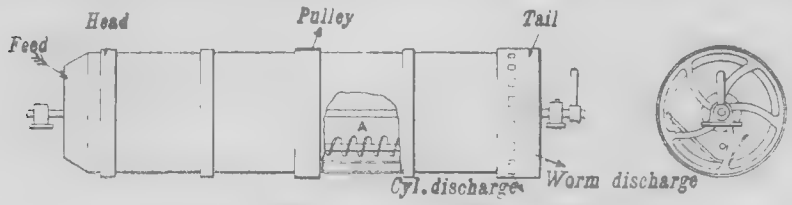
MR. CHARLES HENRY FIRTH, one of the members of the celebrated firm of Thomas Firth and Sons, steel manufacturers, of Sheffield, died somewhat suddenly at Bath on the 1st inst. He had been in failing health for some time, and frequently resided at Bath. The deceased had the management of the gun department at the works.

The Design and Erection of Flour Mills on the Roller System.—XVIV.

WHEAT CLEANING—(*Continued*).

WE shall now return to the wheat, which, after leaving the separating sieves, is in two grades—very large and small. As both grades contain impurities such as barley, rye and cockle, the separation of these seeds from the wheat is the next process in cleaning the wheat.

Barley is extracted from the wheat by passing it through a slowly-revolving cylinder, which is internally semi-perforated with flat bottom indentations of such a size that the wheat is carried up sufficiently high to be dropped into a collecting worm that runs the full length of the cylinder.



DESIGN AND ERECTION OF FLOUR MILLS.—FIG. 22.

The wheat is discharged at the tail end of the cylinder. The barley, on account of its shape, cannot be lifted so high, and gradually works out at the tail of the cylinder. These cylinders are fixed on an incline of 15°, or a fall of 1in. per foot length of cylinder (Fig. 22).

The action of the cockle cylinders is the reverse of that of the barley cylinders. In this case the cockle and other small seeds are lifted up and delivered to the receiving worm marked A (Fig. 22). The wheat being too large for the semi-perforations, passes along the bottom of the cylinder, and is discharged. In the table given below, the sizes and capacities of the various cylinders are given, but it must be remembered that although a cylinder of say No. 4 size (barley) can deal with 25 bushels of wheat per hour, *two* cylinders of the same size will give a better separation. In using two cylinders, the feed of wheat must be *divided* for the two cylinders, or no better result will be obtained than if one cylinder be used.

The arrangement of barley and cockle cylinders varies, as milling engineers hold different opinions on this detail. Then, again, the floor space and height available have to be taken into consideration. Where it is possible, it is best to arrange them in pairs, "three high," having six cylinders in one frame. The cylinders receive their feed of wheat from a vibrating sieve. The object of this sieve is to divide the wheat, so that each cylinder receives a proportional feed according to the quantity of wheat passing over the sieve or vibrating tray.

The above arrangement applies to plants of large capacity—from 40 to 80 sacks (280lb.) per hour. For small roller plants (4 to 6 sacks per hour), where there are only four cylinders—say two No. 5 barley and two No. 5 cockle cylinders—at work, the cylinders may be placed side by side and fed by a rotary wheat grader, making two divisions—viz., head of the sieve (for small wheats, etc.), to divide the feed for the two cockle cylinders; and the tail sheet (for large wheat), to divide the feed for the barley cylinders. This makes a very neat arrangement for a small roller plant, and will work for years without giving any trouble or requiring money spending on it.

CAPACITY AND DIMENSIONS OF COCKLE AND BARLEY CYLINDERS.

No.	Capacity for Barley.	Capacity for Cockle.	Diameter.	Revolutions per Minute.	Length of Cylinder.	Length of Shaft.
	Bush per hou.	Bush per hour.	in.		ft. in.	ft. in.
1	5	7	14	15	4 2	5 1
2	7	12	16	14	5 1	6 1
3	14	18	18	13	5 9	6 10
4	19	25	20	12	6 6	7 6
5	25	33	22	11	7 4	8 5
6	30	40	24	10	8 2	9 3
7	42	55	31	8	9 9	10 11
8	53	70	39	6	11 5	12 6

The capacity of rye cylinders of the same leading dimensions is 25 per cent. greater than the capacity for cockle; the separation of long rye from wheat is best done by means of rye cylinders, short rye with a perforated sieve.

(*To be continued.*)

107,608 TONS of steel were produced in Belgium during the first half of this year.

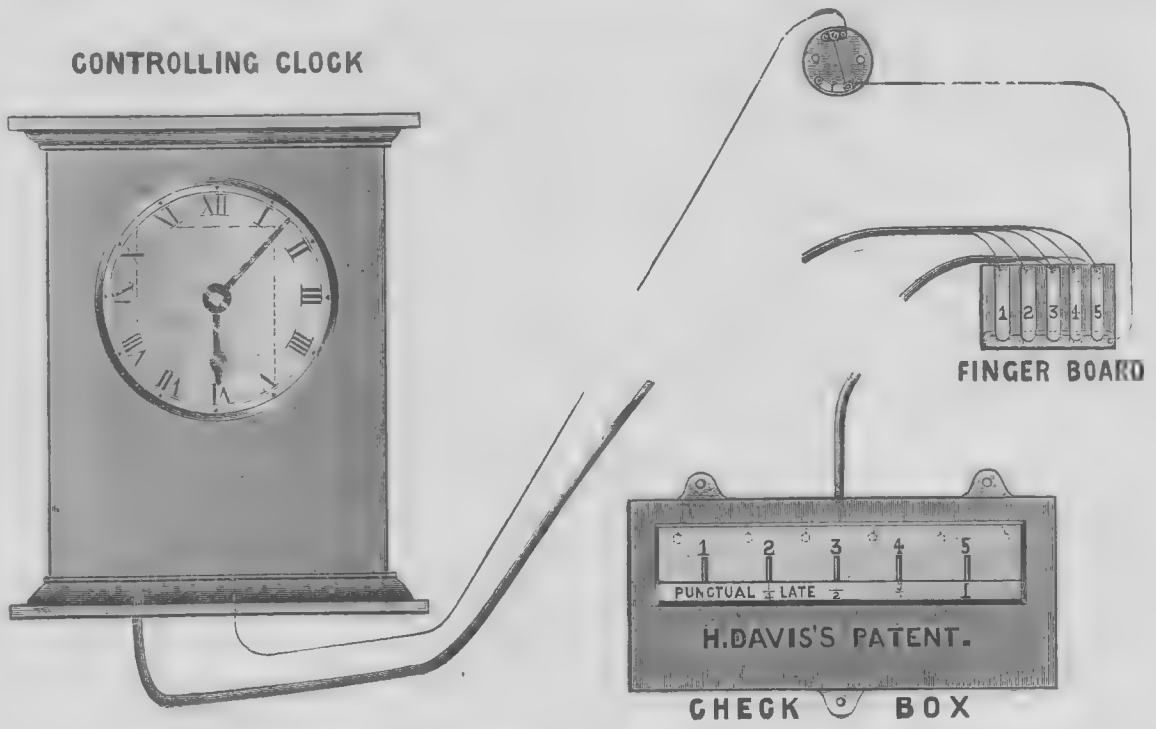
Birmingham Association of Engineers.

THE members of the above association paid a visit on Saturday, the 26th ult., to the City Gasworks, Windsor-street, Birmingham. They were met at and conducted over the works by Mr. C. Hunt, M.I.M.E., who was assisted by Mr. F. S. Green, M.E., a member of the association. The works occupy about 26½ acres of ground, and are classed amongst the best arranged gasworks in the country. They consist of a large retort-house, where there is already at work 1194 mouthpieces, with additional room for 252 more. One of the main features in this house is the inclined retorts patented by Mr. Hunt, and heated by his well-known regenerator system. These retorts are charged by a machine specially designed by Mr. Hunt for these retorts, enabling one man to make a charge of 10cwt. per minute. Another feature in this house was the Foulis hydraulic drawing machines, which discharge the ordinary horizontal retorts. This plant was made and erected by Sir William Arrol and Co,, Glasgow. The other machines employed in the house are designed according to Ross's patent, and erected by Tangyes Limited, Birmingham. The party were next shown eight large purifiers, each measuring 66ft. by 32ft. by 6ft., having covers to each one weighing 26 tons each, which were hoisted and lowered and made to travel when necessary by a crane capable of lifting 28 tons, constructed and erected by Thomas Astbury and Sons, Smethwick Foundry. The two large gasholders were next inspected, they being, perhaps, the largest yet made, each having a diameter of 236ft. and a capacity of 6,250,000 cubic feet. These massive and well-arranged pieces of iron-work were designed by Mr. Hunt, and are well known in the gas world. The party next visited the exhauster engine-house, where are fixed five exhausters and three horizontal steam engines. Two of the exhausters were made by G. Waller and Co., capable of passing 15,000 cubic feet per hour; one by Donkin and Co., of 20,000 cubic feet per hour; and two by Allen and Co., of 15,000ft. capacity. A horizontal compound tandem engine is in this house, having a H.P.C. of 16in. diameter and L.P.C. of 25in. diameter, with an 18in. stroke. The steam for this engine is supplied by one of two Babcock and Wilcox boilers, 141N.H.P. The steam is raised by a "breeze" dust furnace with a forced draught, the engine and fan being supplied by Bumsted and Chandler. One special feature in this house is a small barring or starting engine, especially designed by Mr. Green for starting the large engine made by Allen and Co. The engine, though small in itself, appears to work satisfactorily, and is operated with the greatest ease. The party were next conducted to a room and shown the various methods of testing the gas for its illuminating power. There was also shown a novel water-gas making plant for enriching ordinary coal-gas coming to the governor house, at which place the gas is governed previous to entering the mains that supply the city. —At this juncture, the president, Mr. A. Driver, proposed a hearty vote of thanks to Mr. Hunt for his kindness not only in granting permission to visit the works, but for his condescension in personally conducting the party, in acknowledging which Mr. Hunt expressed the pleasure it gave him, when approached by Mr. Green, to consent to be present and conduct the members over the works, and also to meet an association such as the gentlemen present represented. — A most interesting and instructive visit was then brought to a close.

Electrical Controlling Arrangement for Workmen's Time Checks.

DURING recent years a considerable amount of ingenuity has been expended in the attempt to devise an efficient system of time checking for factories, mills, and workshops where numbers of men are employed. The latest departure in this direction is due to Mr. Henry Davis, of the firm of Messrs. John Davis and Son, All Saints Works, Derby, and is shown in the accompanying illustration. As will be seen, a check-box is provided for the reception of the workmen's time checks, and this is divided into a series of separate compartments, each being provided with a slit or opening through which the checks are passed. Behind each of these openings, a cover or shutter is pivoted, and this is held up clear of the slit by means of a catch formed at the top end of the shutter or cover, and corresponding to a reverse catch on a pivoted arm. Upon this catch being released the shutter falls and effectually closes the slit or opening, thus preventing the checks being introduced into this particular compartment. The pivoted arm closing the check-box shutters successively and at the desired intervals of time. If it is desired to dispense with the controlling clock, a finger-board may be used, as indicated in the illustration. This may be fixed in the timekeeper's or the foreman's office, and by depressing the keys marked 1, 2, etc., the several shutters may be closed as desired. A switch is also provided so that the current may be prevented from passing, except during such hours as the check-box is in operation. If desired, however, the switch may be dispensed with, the contact wheel in the clock being then modified so as to cause the projections to make contact only during the time when the check-box is in use. This apparatus is especially designed for works, offices, shops, warehouses, etc., where no timekeeper is employed, or for the outlying departments of works covering large areas where time may be lost between the main entrance and the employé's particular workshop. Any number of check-boxes may be controlled by one clock.

It will be clear that by using the controlling clock and check-box the closing of the several receptacles for the workmen's checks is performed quite automatically, and in a way which admits of no dispute with the timekeeper. The arrangement is ingenious and not likely to get out of order, and we commend it to the notice of employers who desire to adopt an automatic controlling system for workmen's time checks.



CONTROLLING ARRANGEMENT FOR WORKMEN'S TIME CHECKS.

American and British Workmen and Machinery.*

DURING a recent visit to Great Britain I gave considerable attention to men and machines, and the following are some of my observations and impressions. Not desiring to criticise any special locality, I will simply use the word "Britain"; and in comparing with the United States will use the word "American."

My first attention to mechanics was given to locomotive building, as I wished to solve some puzzling matters, such as the general claim that a given number of men in America will build over twice as many locomotives per year as the same number would in Britain—that American builders can compete against the British for foreign orders and yet pay their men about twice as much per hour. This is rather a big question, but I satisfied myself that I found enough to account for differences as great as the above, partly as follows:—The Americans use more special machinery, and thus make labour more effective; and this is still further increased by division of labour. The easy-going swing in the British works is quite noticeable, as compared with the greater activity and "push" in the American. The British carry a greater deadweight of counting house, drawing office and pattern shop than the Americans—I would venture to state two or three times as much, compared with the number of engines built. Most of the British machines are such as are used generally in machine and engine works, while the Americans use a great many

* By James Arthur, in the "American Machinist."

machines designed and built expressly for locomotive work. The application of milling to locomotive work has revolutionised methods in America of late years, while in Britain it is still comparatively little used. The Americans are easily ahead in vertical and horizontal spindle milling machines, double-face mills, horizontal faceplate turning mills, cylinder-boring and facing machines, screw-cutting machines, special tools for stay-bolt making, flatting of hexagon nuts, finishing cylinder ports, etc., and an indefinite number of ingenious methods, sometimes called "Yankee tricks," all of which tend to an increase of product, as compared with the number of hours labour. The general structure of the American and British locomotives makes a great difference in erecting. The British build a stiff frame of plates riveted and bolted, and all through make a slow, laborious work of erecting the engine; while the Americans actually block up side frames and boiler over wheels, all in position, and seem to finish up all parts at the same time by different "teams" of men, so that the engine is run out of the shop in an incredibly short time. In the matter of labour pure and simple, the most important point in favour of America is the small amount of "hand work," as compared with machine work; so great is this difference that in my first visit to an American locomotive works I actually asked where the bench work was done, after I had practically gone over all parts of the works. In the British works no such question would be necessary, for men literally swarm on what is called by them "fitting" (or bench work), filing, scraping and apparently "fiddling in their time" on work which would be almost finished by machines in America. So prominently does this strike me that it would be little exaggeration to say that the Americans build a locomotive by machinery and unwillingly do a little hand work; while the British make a desperate attempt to build it by hand, but cannot help doing a little machine work. The Americans "mill right to size"; the British "plane" and "slot" in an imperfect manner, and then add more expense, filing and scraping off the "allowance for fitting" which they leave. Even with their cheap labour, this method costs more than the American method. I was informed that this British system is perpetuated by the railways themselves in sending inspectors who insist on extremes in testing the work, which have no practical value but to throw expense on the builders. This method, while necessary and proper in machine tool building, is useless in locomotive work, and sometimes even harmful, for a locomotive never does her best work till she "loosens up" enough to be perfectly free from the danger of binding and heating.

In the stationary engine the engineer can keep joints up much closer, because he can feel them constantly for heating, but in the locomotive there is no way but keeping working joints loose enough for safety. The Americans thoroughly grasp this difference, and use fine machines, and nearly always let in working fits without hand work. I incline to think that types are more uniform in America, and as much greater numbers are built, the ratio which templates, gauges and pattern making bear to the total is in their favour. The British forged wheel is expensive, ugly, and more liable to breakage than the cheaper, heavier, and better-looking cast-iron wheel of the Americans.

Now, why these great differences? Apparently the value of labour in America stimulates the invention of tools, which bring the work nearer a finish, because hand work is the expensive part.

But beyond all this, and permeating the whole, is the greater elasticity and adaptability of the American character, not content even with the best, at any given time, but constantly reaching out for better methods—never satisfied, yet the happiest man on earth—for in him the optimism of constant advance is irrepressible.

Some peculiarities of the British locomotive bear sufficiently on national character to be worth noting here. It is a wonderful little machine for drawing "railway carriages," but when you bring it to America it is practically useless for drawing railroad cars, and is found to be about powerful enough for shunting at the stations. It has a rigid frame, in which the axle boxes are fitted—but you ask, "How does it run on a curve?" Well, the curve is made to fit it, half-a-mile radius being good practice, so it runs round that pretty well. It is driven by inside cranks, and by putting enough metal in these cranks they stand; but as this necessitates driving the wheels through the axles, these axles must be of large diameter. The wheels are forged as if made light, to press easy on the rails, but as some pressure is necessary, even to draw the little "carriages," a mass of iron called the "footplate" is riveted between the frames, and this weight reaches the rails through the axle boxes; but, as we have already made the axles very large, a little more added for this does not make much difference. This footplate is intensely British, for it adds to the stiffness and clumsiness of the framework of the engine, so that if a curve is too sharp, so much the worse for the curve. The "driver" (engineer) stands on this footplate, behind the firebox, along with the fireman, and here another use for the footplate appears, for it is proof even against their massive British boots. Both driver and fireman stand openly in the weather; but this is easily explained, for the Britisher is never happy unless he feels a drizzling rain in his face, and there is not enough sunshine to be considered. Still, there is a limit even here, for sometimes during severe snow or hail-storms, even the British "driver" running up against the wind at express speed, gets more than he enjoys, so the builders take this kindly into account, and put up over the firebox a "storm board," in which two panes of glass, about 1ft. in diameter, are placed, and the humble "driver" is grateful to his superiors. No pilot, bell, or headlight is used, and the engine has a plain, forlorn look, as if a cyclone had ripped off all her trimmings, the result being that "she looks as if she had been cast in one piece." The driving wheels are covered with shields, like small paddle boxes, but I utterly failed to find what they were for; I suppose, however, they are to catch the gravel and sand thrown up by the air currents, and to make sure that it is thrown down again on the axle boxes.

Coming to shipbuilding, it is remarkable how little difference can be noted, in a hurried visit, between the American and British shipyard. In the engine department there is the general difference of method noted in locomotive building, but not so marked as in the latter, except in the smaller details of the work, in which the American methods are quicker and more ingenious. There is enough difference to lead me to the opinion that the cost of production in Britain is not much less than in America, and that this is decreasing. The general method of handling work is more clumsy and laborious, and it appeared to me that more power is wasted in machinery, and more physical force applied by the workmen to produce a given result than in America. Somehow the American strikes the nail on the head more precisely, and drives it home with less cumbersomeness than the Britisher. Everything tends to clumsiness. Forgings are made with a greater allowance for finishing, and consequently deeper cuts are taken off by the machines; and not only this, but there is less *cutting* done, the Britisher, apparently, preferring to *tear* or *force* off the metal with a blunt, heavy tool. It is evident that the designers of machines must take this into account, as most of the details are too heavy, noticeably the feed motions. The answer to criticisms on this point is always "Strength, strength, strength"; but the American designer has shown that mere weight of metal is not always strength, but often the opposite. The British designer seems to put as much metal as possible in the framework; then he tries to make the moving parts heavy enough to break the frame, and he often succeeds. Hence the poor workman is loaded by everything he has to move; he has, therefore, to use more force, his motions are more clumsy and slow, and he effects less. Where the British designer would throw in and out a feed with a stout lever, the American would do it more effectively by a little knob moved by the fingers.

But my British friend says, "These little gingerbread Yankeeisms do not last." Yes they do—if used by the American workman, for whom they were designed. And this is just the kernel of the matter; for the British workman would find it awkward to move a little knob with his fingers—he nearly always takes hold with his whole hand. Anything movable is with him a hammer, and everything stationary an anvil. This deficiency in delicate touch is very plain, and influences all his actions. He appears to have little sensibility in the points of his fingers; hence his tendency to *grasp* everything in a "clumsy-fisted" manner. Amongst unusually heavy tools I noticed the four-jaw chucks, and asked one of the tool builders I met for the reason, and he informed me that he had tried the American chucks and made a complete failure, as his workmen broke them in a short time, and he was compelled to build the heavy style. He did not dispute my assertion that the American workman, with his lighter chuck, handled work quicker. Now, observe what the British workman *gains* by carelessly breaking tools of reasonable weight: he laboriously handles tools nearly twice the weight they ought to be, hour after hour, day after day, year after year.

This machine builder was by far the best-informed man I met, as to British and American practice, and the only one I found favourable to the latter; but he had made a tour in America and made comparisons for himself. In his works I found three of the most distinctly American machines—viz., universal milling, universal grinding, and vertical spindle chucking machines, all by the firm which has practically created them—the Brown and Sharpe Manufacturing Company, Providence, R.I.

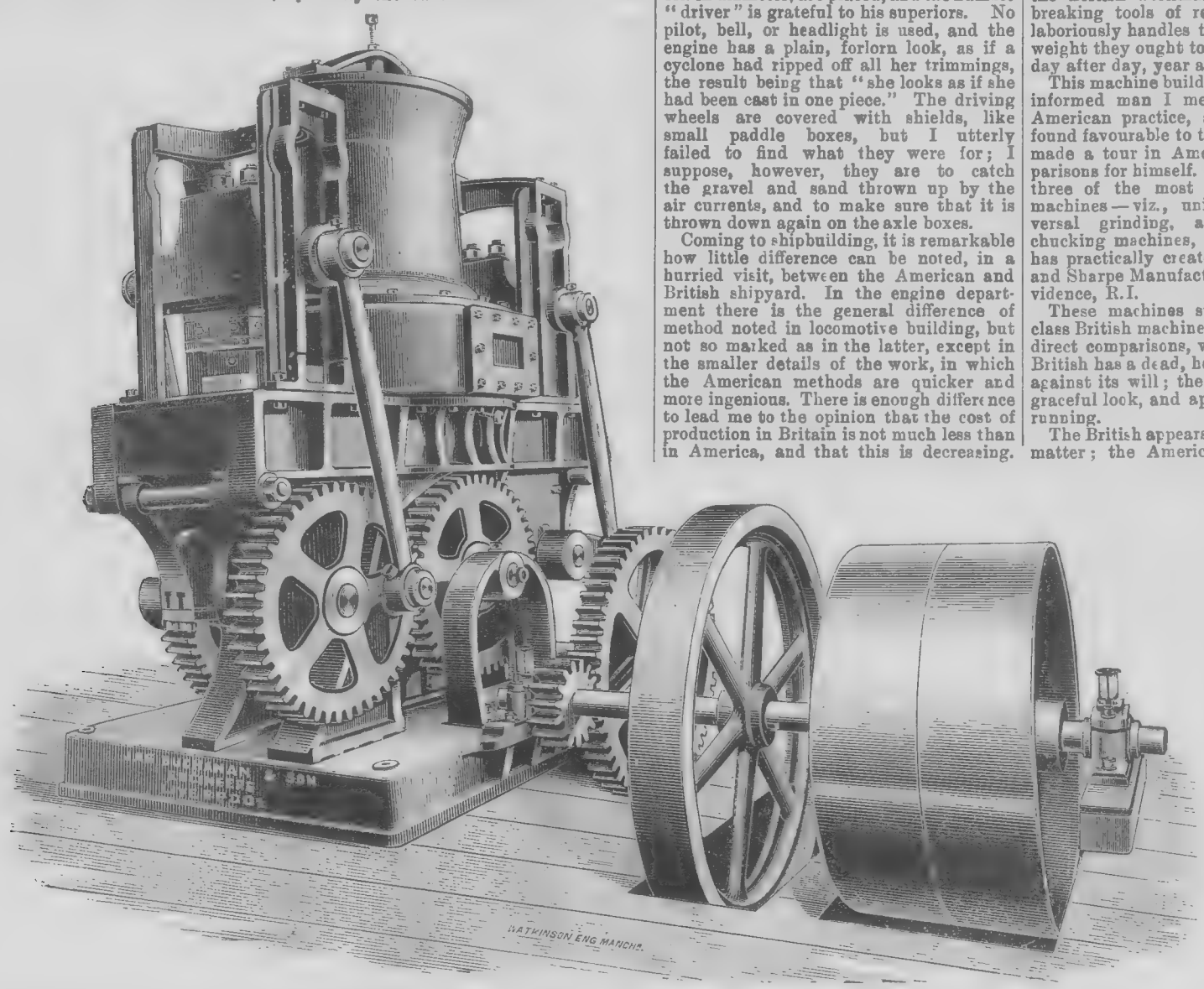
These machines standing among first-class British machines enabled me to make direct comparisons, with this result. The British has a dead, heavy look, as if driven against its will; the American has a live, graceful look, and appears as if it enjoyed running.

The British appears as if made from inert matter; the American seems to have a nervous system. The British is stolid; the American bright. The British is prosaic; the American the poetry of mechanics. The British is pessimistic looking; the American optimistic. The British looks as if built by a Calvinist who believed in hell; the American the creation of a Universalist. The British is noisy; the American quiet. The British looks brutal; the American refined.

The prevalence of noise and jar in British machinery is amazing, and the workmen appear entirely indifferent—so much so that you would almost suppose they liked it! It is evident that the British designer has little incentive to work for quiet-running machinery. In America quiet running is a leading characteristic, and is placed at the top in advertisements and descriptions, and adds to the selling price of the machine.

Does not this indicate an obtuseness and stolidity in the British workman, and a nervous sensibility in the American?

The greatest cause of this noise in British machinery is their persistence in the antiquated system of cast gear wheels. The Americans cut the teeth, and for very large pitches cast them large and then plane all over. In one of the largest British works I talked with the engineer ("driver") of a department, and could hardly hear him for the noise and pounding of his engine, which he did not notice in the least. I asked him if he had taken indicator cards lately, and he replied that the makers had



THE "INVINCIBLE," BRICK AND TILE MAKING MACHINE.—FIG. 1. (*For description see page* 236.)

examined "her" lately, and he supposed they took cards.

The mental attitude towards American improvements is very funny—that is, to the American. I criticised a clumsy machine, and received this crushing answer: "Who had it first?" How could a machine be improved in America if the British had it first, and used it most? He spoke, and the question was settled. It was stated to me, with that seriousness so peculiarly British, that "we have been longer at it, and, having more experience, we must be in advance of America!" I found that this very experience was often the weak point, for it had led to conventionalities in method which stand in the way of advance. In some instances methods would become fixed in localities, and even in families, till skill appeared to become hereditary, and this state of matters was always associated with imperfect and primitive machines and tools. Thus personal skill became the most important factor, so that the employer was put more in the power of the employé. In America it is just the opposite, for machinery and methods are the most important factors, and are brought to such a high point that "any handy man" can be quickly taught.

In one instance, I was shown work being done on the slotting machine, and as it was just the work for which the vertical spindle milling machine was invented, I challenged the method; but the manager promptly informed me that he had tried the miller, and "timed" it against the slotter, and the latter was ahead. No doubt about it, and while that twenty-year manager and his present force of workmen are employed the slotter will be still ahead. To illustrate this difference between acquired skill and automatic machinery, let us suppose a British machine works suddenly put under boycott by skilled labour; it would be practically wiped out. Now, suppose a similar condition in an American works—what would be the result? Simply that men would be taken from "labouring work," and taught so soon that little serious delay would be suffered. In both cases I assume that manager and foremen remain.

More than this—boys from farms in America have introduced some of the best improvements. Why? Because they were not taught the "proper" way, and therefore tried some original methods, and often made a hit. The young American is much given to "rigging up" some attachment to his machine, and the foreman knows enough generally to give him reasonable liberties, and his success is often remarkable. In Britain he would be told to "obey orders." This brings us to the fundamental Americanism — the recognition of the individual. In one instance which I know of, a workman attempted to have a simple improvement tried, but was told that the manager did not like such things, and that he preferred a workman to "keep his place." He refused, and now occupies a much better place than that manager ever did. America says a man's place is the highest he can reach honourably.

In questioning British workmen you are impressed with their stolid carelessness in answering, partly from ignorance and partly from the danger of "knowing too much for their places."

I hardly think it would be possible to make clear to an American, who had not visited Britain, this peculiarity which runs through nearly all grades of society, but shows most plainly amongst workmen—viz., an indefinite and indescribable fear that something they may say or do, even inadvertently, may offend some of "their betters." This is in distressing contrast to the bright and easy spontaneity of the American. In Britain the workman will answer you in a short, gruff way, without lifting his head from his work, almost as if he said: "You ought to be aware that I am not supposed to know anything;" while in America he will surprise you with the knowledge he has beyond what he is doing, and he will not hesitate to stop work for a short time to explain anything you may ask about, and he is in no danger from foreman or manager by so doing, because they know that he is more efficient with this liberty than without it.

The British workman is always a "workman"; he wears practically the same clothes the year round, and they are made and advertised for "working-men." He goes to and comes from his work in the same clothes he works in, and rarely washes his hands or face at the works, but comes home with all the dirt of the forge or the foundry, and often takes back quite a little of it next morning.

Look at him carrying his coffee can; he does it so well that there is no hope. Note his gait—a "workman," and for the future, still a "workman." See his son by his side—the coffee can, the lunch, the gait, the heavy boots, the shoulders getting round, the stunted growth and prematurely wise face, the stolid expression, and you exclaim—A "workman," hopelessly a "workman"! He said to me, "I'm only a common working-man." Why should he not keep his place? I talked with another about the acquisition of knowledge and rising in position; he replied, "A man can only make a living!" It took a good many generations to make these men, and it will take many to lift them up again, if it can ever be done. Does any one suppose that Americans could be bred down to this? Or, are these only possible in a community founded on the class system? Is not this the result of a social system in which a man has his place?

A brilliant woman asked me, "Why is it that an emigrant returning from a few years' residence in America nearly always comes elevated and brightened, while from any other place he usually comes just as he left, or worse?" Simply the freedom of individualism in America. It is here that the greatest fundamental difference exists between the two countries. In Britain you may be a "greengrocer," or a "coal-heaver"; you may be a "gentleman," or a "prince" out of gaol; but never, never a "man." There is no escape from this. In America the first assumption is that you are a man and a citizen without blemish, and even if you fall short of this, your neighbours will assist you upwards, for they have no interest in doing otherwise. The element of contest is left out, for you do not encroach on anyone. In Britain it is just the opposite, for in rising you are always an object of suspicion, and those "above" you resent you as an intruder. Still the vile, unjust class system. Now, to come back to the pertinent question of my fair friend. If there is any good material in an emigrant (and there generally is), he will feel these things in America very soon. I say "feel," for it is deeper and more potent than any written or spoken language. If there is even a seed of self-respect in him it will develop. Not only can he rise freely; he will, in a certain sense, be pushed up, for Americans resent humility—which he will likely show a little from habit. The American who has succeeded will act as if saying to him, "Step up here; we believe in you." There is a charm in the recognition he receives as he climbs up, of which he knew nothing in the Old World, and he will gradually acquire that uniformity of manner which marks the American. It is hardly possible to take the Britisher's manners seriously: now strutting around, with his nose in the air, that he may sustain his dignity amongst his "inferiors"; then doubling up quickly like a jack-knife, till his head almost touches the ground, when a real "big bug" looms up. I have seen a man who, under ordinary circumstances, was almost too dignified to look at the ground, dancing around a superior like a pet dog! Under these conditions the workman does as well as could be expected, and as there are distinct signs of improvement, partly native and partly a reflex action from America, there is good hope for the future.

Manufacture of Steel in the Crucible.

It is certain that malleable pig iron and even cast steel are capable of rendering service under circumstances which are determined by the thickness itself of the pieces run off with these metals. When the thickness exceeds 25 to 30 millimetres, these are not sufficiently decarburetted by the oxidising annealing, and under such conditions they are certainly not equal to good ordinary pig. There would thus be no advantage in substituting steel for malleable pig, as steel by its nature, and on account of the high temperature necessary for running it into the mould, would fill it with difficulty, and would produce pieces of a bubbly character, in addition to requiring almost the same annealing as malleable pig. For larger castings, however, steel run off without bubbles has greater resisting power, and may always be employed with safety instead of iron. Manufacturers of malleable pig can utilise their material for the production of steel castings; the nature of the substance submitted to fusion is the only difference. While the average quantity of carbon contained in the mixtures employed for malleable pig is about 2 to 3 per cent., the quantity in the mixtures employed for crucible cast steel varies between 1 and 1·5 per cent. The proportion of carbon will be greater in proportion as the size of the castings diminishes, as metal which is too carburetted requires an excessively high temperature to become fluid, and to fill exactly the delicate details of a small mould. Moreover, crucibles will deteriorate very quickly when they are employed for the fusion of metal with little carbon, and their consumption will form a very important item in estimating the cost of production.

In principle it is better to melt a hard metal, and modify it afterwards by suitable annealing. The oxidisation of the bath, which is the principal cause of bubbles, is avoided by the addition of substances more oxidisable than iron, such as carbon, manganese, silicon, and aluminium. Carbon, in excess, in burning retards the oxidisation of the iron. It is rarely that carbon alone is added. Ordinarily it accompanies the other reagents in special kinds of pig. Manganese acts with certain efficacy in deoxidising the metallic bath, the excess of manganese forming, with the iron, an alloy which sensibly augments the hardness of the metal. Silicon also acts with great energy. It transforms the combined carbon into graphitic carbon, but it communicates a certain degree of brittleness. The action of aluminium is analogous to that of silicon, but the former is much more efficacious in its employment. Metallurgists are astonished at the smallness of the quantity necessary to be used. One-thousandth part of aluminium added to a bath of oxidised steel usually suffices to furnish a metal which is sound and free from bubbles. The beneficial action of aluminium is not yet explained with certainty. The manganese is employed in the form of spiegel, containing less than 25 per cent. of manganese, and as rich ferro-manganese, with 70 to 80 per cent. of this metal. Silicon is introduced by means of grey pig, or, better, in the form of ferro-silicon or silico-spiegel. With regard to aluminium, it is most frequently added in the form of metals sold as pure. The charges of the crucibles vary with each foundry and sometimes with each fusion, according to the nature and dimensions of the castings to be produced. Ordinarily the composition of steel for castings is kept within the following extreme limits:—Carbon from 0·8 to 1·50 per cent.; silicon from 0·4 to 0·75 per cent.; manganese from 0·1 to 0·60 per cent. The quantities of phosphorus and sulphur need not be considered. — "American Manufacturer."

Shipbuilding Notes.

Messrs. M. Paul and Co., Dumbarton, have just built a small launch of delta metal. She is 27ft. in length.

Messrs. Wm. Simons and Co., Renfrew, launched on the 29th ult. a hopper dredger built to the order of the Harrington Harbour Commissioners. Her place in the yard will be occupied by a dredging vessel ordered by the Admiralty for special service at Portsmouth.

The trial trip of the s.s. "Shiek," built for the Bedouin Steam Navigation Company, of Liverpool, by Messrs. Palmer and Co., Jarrow, took place on the 3rd inst. The length of the "Shiek" is 388ft., width 45ft., and 31ft. 3in. mould. The vessel was loaded with 6500 tons of coal, and the mean speed obtained was 11 knots.

On the 3rd inst., a steel screw steamer was launched by Messrs. Wigham, Richardson and Co. from their Neptune Shipyard, Newcastle-on-Tyne. She is 285ft. in length by 38ft. beam. The engines, which, with the boilers, are also being constructed by Messrs. Wigham, Richardson and Co., are of the triple-expansion type.

There was launched on the 1st inst., from the shipbuilding yard of Messrs. John Readhead and Sons, West Dock, South Shields, a steel screw steamer of the following dimensions:—Length, 306ft.; breadth, 41½ft.; depth, 23ft. 7in. moulded. She is fitted with triple-expansion engines, built by the same firm, having cylinders 23, 37½, and 61½in. diameter by 42in. stroke, steam being supplied from two large steel boilers, three patent furnaces being fitted to each.

The s.s. "Arapahoe" recently had her trial trip off Hartlepool. She has been built by Messrs. Wm. Gray and Co. Limited, for the Arapahoe Steamship Company Limited, of Liverpool. The vessel is 400ft. long over all, 48ft. 6in. in breadth, and 31ft. 6in. deep, her deadweight capacity being over 7300 tons. The engines have been supplied from the Central Marine Engine Works of West Hartlepool, the cylinders being 37½, 43½, and 73in. in diameter respectively, with a piston stroke of 46in. The vessel attained a speed of 12 knots, which was considered satisfactory.

On the 3rd inst., there was launched from the yard of Messrs. Robert Stephenson and Co., Limited, Newcastle-on-Tyne, a screw steamer. The dimensions of the vessel are as follow:—Length B.P. 324ft., breadth extreme 42ft. 1in., depth moulded 29ft. 2in., and depth of hold to tank top 26ft. 4½in. The engines, which will be supplied by Messrs. Blair and Co., of Stockton-on-Tees, are of the triple-expansion type, having cylinders 23½, 39, and 64in. diameter by 42in. stroke. These are supplied with steam at 160lb. pressure by two large steel single-ended boilers.

The Manufacture of Small Arms.

At the ordinary meeting of the Institution of Civil Engineers, held on Tuesday, the 29th ult., Mr. Harrison Hayter, president, in the chair, the paper read was on "The Manufacture of Small Arms," by Mr. John Rigby, M.A., superintendent, Royal Small Arms Factory, Enfield.

The paper dealt with the application of special machinery to the manufacture of military arms whereby the continued reproduction of accurate copies of an original pattern was assured. The history of this modern industry was briefly sketched, and it was illustrated by a description of the manufacture of the magazine rifle at Enfield. The interchangeable system, and the credit of applying machine work to the production of military arms, belonged to the United States. The first machine-made interchangeable small arms introduced into England were Colt's revolvers, displayed in the exhibition of 1851. Subsequently, in 1852, Colonel Colt imported and erected machinery, with which he carried out a contract for revolvers with which the English sailors were armed during the Crimean war. In 1857 the War Office commenced the "interchangeable" manufacture of the Enfield rifle. Birmingham contractors had been slow to follow the example thus set; and, although more than one English firm could produce gun machinery of the most advanced type, no British manufacturer had succeeded in establishing a foreign trade in military arms. The causes of this were traced in the paper, and suggestions were made with regard to stimulating the industry. Small arms might be regarded as comprising rifles, pistols, lances, swords, and bayonets. All those weapons were, or had been, produced at Enfield in considerable numbers.

The British rifle, officially termed the Lee-Metford Mark I., had 82 separate components, in the production of which 950 different machines were employed, as well as various processes that did not require machines. Up to the time of the Crimean war, the musket barrel was a comparatively rude tube of iron, lap-welded under rolls, with a cylindrical bore of about ¾in. in diameter. The rifle barrel of the present day was a steel tube of the most accurate workmanship, $\frac{3}{10}$in. in diameter of bore, rifled to $\frac{1}{2000}$in., and so closely inspected that the most minute grey or seam in the bore was sufficient to condemn it. The steel used in the manufacture of these barrels was supplied to Enfield in solid round bars, 1⅝in. in diameter, and 15½in. long. The first operation was to draw out the bars to the required external form, by passing them through ten pairs of rollers working tandem. This was done at a single heat. The bars were then taken to the forge, where the swell at the breech was stamped to the required shape by the steam hammer. The special machines for the next operation — that of straightening the bars — and the processes of drilling and finishing the bore were described in detail. In British small-arm factories, the rifling of the barrels was effected by planing out each groove separately with a hooked cutter; whereas, in Continental and American practice, the grooves were formed by several angular cutting edges on one tool, following one another after the manner of a single-cut file. After rifling, the bore was finished by a few passes of a rapidly-spinning lead lap fed with fine emery. The body of the rifle was made of steel—preferably a mild crucible cast steel—which had to be suitable for hardening in those parts which were exposed to the pressure of the bolt. It was forged under the steam hammer in two operations, and was then drilled and otherwise worked to its final shape and dimensions. The recess into which the end of the barrel was screwed was milled out in a specially-contrived machine, so as to ensure that all barrels should screw up to the same place, and that the distance from the breech face to the shoulders that hold up the bolt when closed, should be always the same. Automatic shaping machines were employed to form the bolt, which could not be turned in the lathe throughout its length. It was then finished in a special machine, in which it was forced between cutters adjusted by micrometer screws. After leaving the machines, the bolts were hardened in oil—the temper of the handle being reduced in a lead bath.

Generally speaking, the other components of the rifle received their shape in either mills built up to the required profile, or copy-milling machines. Drifting had been employed with good results at Enfield, and was applied to form all such slots as had parallel sides, and were not cylindrical. Contrary to the usual practice, the drifts, armed with successive

teeth increasing in size, were pulled through the holes—a process that had proved very useful in interchangeable work. Grinding by emery wheels, as a substitute for finish-milling and filling, had been usefully developed at Enfield, and was largely applied to finishing the backsight leaves and slides.

It was sometimes supposed that a machine once adjusted to turn out a component of a certain size and shape, was capable of reproducing such in large numbers, all absolutely identical. But this was so far from being the fact that it might be said that no die, drill, or cutter actually made two articles alike. The wear of cutters and dies proceeded slowly but surely, and it was only possible to turn out components of sizes varying between certain superior and inferior limits. In small-arm manufacture a variation of about $\frac{1}{1000}$th inch was tolerated; in small components it was much less, whilst in some large pieces the variation allowed was greater. Hard gauges were used to check the sizes in each operation; and it was the duty of the machine tender to cause readjustment to be effected as soon as the gauge informed him that it was necessary. In order to ensure the interchangeability of components made at different factories, a staff of viewers examined and gauged all the separate parts in certain stages of manufacture—stamping them if found to be correct. All barrels were proved before and after rifling, by firing heavy charges in them, the final test being calculated to apply a pressure of 24 tons per square inch.

The determination of the sighting in new pattern arms, or for a change of ammunition, involved the finding of, first, the muzzle velocity, and, second, the effect of "jump," or angle of vibration. Next, the angles of departure for the various ranges were ascertained, and corrected for the "jump."

The rifle stocks were made of walnut wood, seasoned for two or three years. They were first turned in self-acting copying lathes, and were subsequently recessed in special machines, to receive the various metal parts. The making of screws, and the browning and polishing of the several components, were touched upon; the final operation being the fitting together of the complete arm in the assembling shop.

Since 1889, all swords and sword-bayonet blades made at Enfield have been machine forged, being first roughly reduced under the rider machine hammer, and completed in segmental rolls. For hardening, the blades were heated in a specially contrived furnace, in which they did not come in contact with the fuel; the desired curve was given by screw pressure; and they were hardened in an oil bath. Tempering was effected in ovens, upon the shelves of which the blades were left until they assumed the required colour. After tempering they had to be straightened, ground and "stiffened."

In conclusion, the subject of the testing of swords and bayonets was dealt with, and the part taken by civil engineers in the scientific construction of military weapons alluded to.

Steam Pipes.

(*Concluded from page* 228.)

THE CHAIRMAN, in opening the discussion, remarked upon the comprehensive and exhaustive character of the paper, which, he thought, reflected great credit upon Mr. Brett, and after recapitulating the various points raised by the author, said they afforded a very wide field for the exchange of experiences and opinions. He hoped that both the makers and users of steam pipes would place their views before the meeting, for there could be no doubt that in these days of high pressures the subject was one of the first importance to marine engineers.

Mr. F. W. Shorey fully agreed with the Chairman that very great credit was due to Mr. Brett for the manner in which he had brought this subject under their notice. The author had gone very fully into the whole matter, and although no paper of the kind could deal with every point, he should like to have heard the views of the author as to what were the best expansion joints. Mr. Brett had said that explosions and accidents were sometimes due to bad workmanship. They were all painfully aware of that fact. But what, he would ask, was the best method of preventing some of this poor brazing? We had now come to times of very high pressures, and it was most important that steam pipes should be as sound and as perfect as they could be made, because when one of these pipes split up on board ship it was impossible for those below to get out of the way quick enough. Indeed, he believed the time would soon come when they would have to give much more attention to steam pipes than had hitherto been bestowed upon them. One method of preventing accidents had been tried with very satisfactory results. The plan was for the stop valves to the steam pipes to be opened as soon as the fires were started, so that as the temperature rose in the boilers the temperature rose in the steam pipes also, and there was thus a gentle steady expansion right through. He believed that many steam pipes burst through water hammering and through too sudden expansion. With regard to scarphing, he did not think that that was a matter with which, as marine engineers, they had very much to do, but he fully appreciated the importance of having the scarphs properly made, and he believed that a very great fault often found was that one scarph was not put on level with the other, so that a kind of gutter was formed, and a weak place was at once created. There was also a danger in making the scarph too long. If engineers who had to look after new engines would see to points of this kind, he thought a lot of trouble would be avoided. He was acquainted with Elmore's patent tubes, and believed they were not proving so satisfactory as was at first anticipated. With regard to the idea of strengthening steam pipes by fixing hoops round them, his opinion was that while they might prevent a slit from going up a pipe, they would not strengthen the pipe very much. On this point Mr. Shorey quoted from an article in the "Engineer" of New York, which, referring to some tests of copper pipes by American naval engineer officers, said:—"A comparison of the results attained shows nothing in favour of banded pipes; on the contrary, it appears possible that under the conditions of test the bands may have exerted a detrimental influence on the final strength of the pipe." It was like putting a new piece of cloth in an old coat; the new cloth, being the strongest, tore away the old material.

Mr. R. Leslie said that he had had a considerable experience of copper pipes, having been in 20 different ships, and it seemed to him that Mr. Brett had treated the subject very fairly throughout. Indeed the points set forth in the paper were to his mind as nearly correct as possible. There were many matters connected with the manufacture of copper pipes that needed explanation, but really the two principal points, and the only two which he regarded as of primary importance, were good material and good workmanship. If these two points were secured the superintending engineer could, he thought, look after the rest. He fully agreed with Mr. Shorey as to the evil likely to result from turning steam of 300° to 350° on to cold plates, which was like throwing anybody into a bucket of ice. The shock was too great, and if there was a weak spot in the pipe a shock of this kind was just the thing to find it out. In avoiding this evil he would go even further than Mr. Shorey. When he went to sea he had all the stop valves opened up on the fires being lighted, so that the engines as well as the steam pipes were heated up at the same time that the boilers were heated up. Engineers on board ship could not be too careful in the way they treated steam pipes when turning on steam. With regard to the merits of copper pipes, given copper of good quality and good workmanship, there was not much to fear from copper steam pipes if they were properly treated. There seemed to be an ample margin of strength allowed, and if properly made and carefully treated there was no reason why they should not run for any number of years. But if this water-hammer action was allowed to go on in the pipes, they might just as well put them under the steam hammer at once, for no pipe would stand that.

Mr. White, after remarking upon the importance of avoiding vibration as far as possible in connection with steam pipes, observed: Make the pipes the proper size, give them the proper bend and the proper length, joint and build them up properly, and do away with the vibration, and copper pipes will give perfect satisfaction.

Mr. Baker, who stated that he was connected with the trade, dealt with several details of copper-pipe construction, and explained what, in his view, were the causes of some of the defects complained of. Referring to Elmore's patent, he said it was a copper-depositing process, and the surface of pipes constructed on this system was a series of waves throughout. If they bent a straight pipe made on this plan, would it stand? So far as he knew it had never yet been tried.

A Member: Why not, if it is a homogeneous substance?

Mr. Baker: Well, I ask the question. It has never been tried yet.

A Member: Could not the deposit be made on the bent pipe?

Mr. Baker: That I do not know. He went on to say that engineers grumbled a good deal about upright joints, but it was because as a rule they were not properly fitted. If an upright joint was properly bedded and brazed there was no better joint in the world. He complained that copper pipes were greatly handicapped, and because they would not always stand all the strain that was put upon them, they were blamed for everything.

After some remarks from Mr. Greer and Mr. Wilson,

Mr. C. McEachran said the author of the paper under discussion had suggested something about putting drain pipes in steam pipes. He (Mr. McEachran) thought it quite unnecessary to do anything of the kind. His experience of drain pipes was that they were carried away and caused more trouble than they were worth. If, as recommended by Mr. Shorey and Mr. Leslie, steam was got up in the boilers, steam pipes, and engines at the same time, there would be no necessity for drain pipes—that is, if the steam pipe was above the level of the boilers. If the steam pipe had a bend in which water could lodge there must be a drain to it, but it was very seldom that steam pipes were so constructed. He objected to any arrangement by which the steam pipe was constructed in a trap form. There ought to be a bend in all steam pipes, even if it was possible to carry them perfectly straight. If they had a straight steam pipe they were bound to have a breakage of some sort. The bend, however, was generally made very easy, and so that no water could lodge in the pipe, although it did not matter if water was in the pipe so long as the steam could pass over it. A safety valve was much more necessary on a steam pipe than a drain pipe, and he thought that even now a safety valve was perhaps as necessary on a steam pipe as on a boiler. Some of the explosions that had occurred might have been due to higher pressures than were believed to have existed, and now that they had pressures of 160lb. and 180lb. per square inch, there ought to be safety valves on the steam pipes in the same way as there were on the feed pipes. Reference had been made to what had been described as hammer-water action in steam pipes, but there was no rebound of water in a steam pipe that was properly heated as steam was got up. If an engineer had plenty of time in which to get up steam—and he ought not to get up steam without plenty of time,—this water-hammer action would never take place. The whole trouble arose through neglect or carelessness in not starting to get up steam early enough, and it was unreasonable to expect that a cold pipe would stand the shock of the temperature of steam at a pressure of 160lb. per square inch.

In the result the discussion was adjourned until Monday, the 28th ult., and Mr. Brett was accorded a hearty vote of thanks for his paper.

The discussion was resumed on the 28th ult., the chair being occupied by Mr. W. J. Craig, member of council. The proceedings were opened with a *resumé* of the paper, and supplemented with a few remarks read by the author bearing on the points raised previously, in the course of which he referred to the movements and expansion of copper pipes, and the methods of preventing fractures from extending to a dangerous length by spirally-wound strips of a rounded section and of the same material. Vibration, he maintained, was a source of danger by changing the condition of the metal and making it brittle. With regard to water hammer formed by a bubble of steam in water, and its resulting force, he (the author) was of opinion that its effect was purely local, and more dangerous at the side seams of the crown of a bend.

An animated discussion ensued, which was taken part in by Messrs. Cleghorn, Tyler, Wilson, the chairman, the hon. sec., and others. It was pointed out that the destructive action caused by water hammer occurred without regard to any fixed or abnormal pressures, several cases being cited in support of this theory. Water, automatic traps, and other devices named were strongly advocated as a means of preservation, including a process of periodical annealing. A portion of a copper pipe which had been tested to destruction was kindly submitted by the hon. secretary for examination. This pipe had been subjected to a pressure of 1200lb. to the square inch before fracture, which took place at the lap joint, the factor of safety being 7·5.

Reference was also made to the deposition of copper direct from the crude ore in the manufacture of solid drawn pipes.

Trade Notes.

Messrs. Vickers, Sons and Co. Limited, Sheffield, have recently completed a large gun weighing over 70 tons.

Messrs. O. L. Kummer and Co., of Dresden, have secured the contract for the electric lighting of the harbour of Magdeburg.

The Baldwin Locomotive Works, Philadelphia, have contracted to build 60 locomotives for the Baltimore and Ohio Railway.

Messrs. Robert Napier and Sons, Govan, have secured an order for a screw steamer from Messrs. Sloan and Co., Glasgow and Bristol.

Messrs. T. Firth and Sons, Sheffield, are making a pair of propeller shafts of their special steel cased in gun metal, for the Earle's Shipbuilding Company.

The new engineering and brass works belonging to Messrs. H. Watson and Sons, Newcastle, are expected to be ready for occupation in January next.

We learn that Messrs. James T. Donald and Co., of 345, Argyle-street, Glasgow, have been appointed the agents in Scotland for Mr. Peter Brotherhood's engines.

The directors of John Brown and Co. Limited, Atlas Works, Sheffield, recommend an interim dividend of 10s. per share on the ordinary shares of the company.

Messrs. Peterson, Honeyman and Co., Glasgow, have contracted with Messrs. Russell and Co., Port-Glasgow, to build for them a steel sailing ship of 650 tons deadweight.

Messrs. P. and W. Maclellan, Clutha Works, Glasgow, have received an order for the construction of 400 10-ton steel goods wagons for the East Coast service in India.

Messrs. Goddard, Massey and Warner, of Nottingham, have been awarded the contract for the plant and machinery required for a 6-cell refuse destructor for the city of York.

Messrs. William Hamilton and Co., Port-Glasgow, have contracted to build a steel sailing ship of 3150 tons deadweight capacity for Messrs. W. and J. Crawford, Greenock.

Messrs. Galloways Limited, Manchester, are supplying the reversing engines, hydraulic machinery, and boilers for the extension of the Round Oak Ironworks Company's steelworks.

The Clydebridge Steel Company, Cambuslang, have received an order for 7000 tons of plates, required for three steamers which Messrs. A. Stephen and Co., Linthouse, have contracted to build.

As we go to press we learn that Magnolia Metal has been awarded the gold medal at the Italian-American Exhibition lately held in Genoa. This is the third time that this metal has obtained the highest award in its class at various exhibitions.

Messrs. Lowdon Brothers, electrical engineers, Dundee, have secured a contract for lighting the Eden Valley Linen Works, Freuchie, Fifeshire (Messrs. William Lumsden and Son), by electricity. The installation will consist of 100 16-candle lamps.

Messrs. Clayton, Sons and Co. Limited, of Hunslet, Leeds, have just completed, for the South Metropolitan Gas Company, at their East Greenwich station, the largest gasholder in the world. The holder is 300ft. in diameter, and is the first six-lift holder that has been erected.

The Unbreakable Pulley and Mill Gearing Co. Limited, West Gorton, have secured the contract for the supply of the shafting, gearing, and pulleys for a new mill at Failsworth. This company has also secured the contract for the supply of the shafting, mill gearing, and pulleys for the new extension of the Great Eastern Railway Company, at Stratford, London.

It is reported that one of the leading iron concerns in East Worcestershire has just entered into an important contract for the supply of chain cable iron for the Russian Government. The iron is said to be required for vessels chiefly navigating on inland waters. Similar orders have not gone to that district for a considerable period, owing to the increased tariffs and the development of the manufacture in Russia.

Readers of "The Mechanical World" are invited to send to the publisher of "Good Health," the new weekly paper devoted to food, drink, medicine and sanitation, for a parcel of specimen copies, which will be sent gratis and post free, for distribution among their friends at home and abroad. Address, 391, Strand, London, or New Bridge-street, Manchester.

Wheel cutter in metal only. Every description of gearing. R. CHIDLAW, 43, City-road, Manchester.

Our Monthly Register contains 4600 lots of engines, tools, and machinery. Britannia Tool Factory, Colchester. 2d. post free.

Having regard to the enormous circulation of THE MECHANICAL WORLD, the Editor suggests that it is by far the best medium for the insertion of every kind of "Wanted" advertisement, and the price is only one halfpenny per word. The Editor will be glad if MECHANICAL WORLD readers will kindly bear this in mind as occasion arises.

THE "INVINCIBLE" BRICK AND TILE-MAKING MACHINE.

MESSRS. JAMES BUCHANAN AND SON, ENGINEERS, LIVERPOOL.

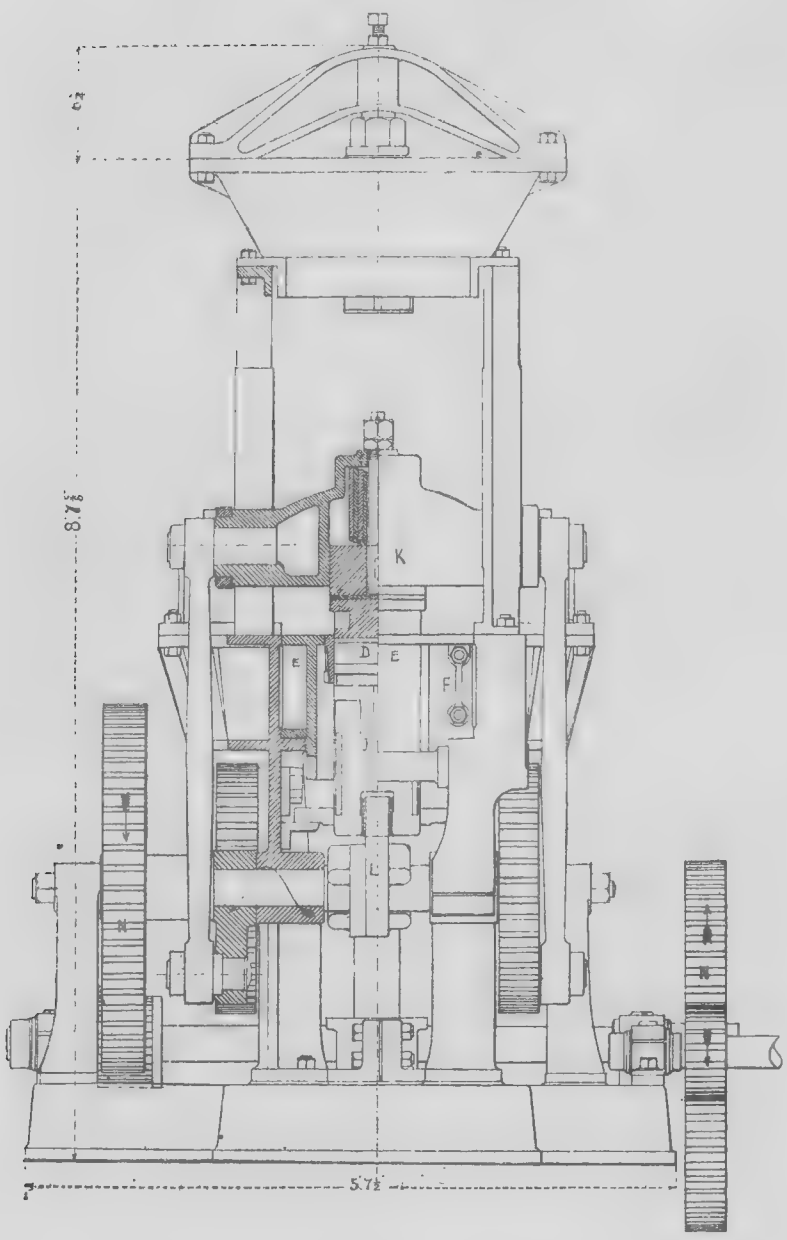


FIG. 2.

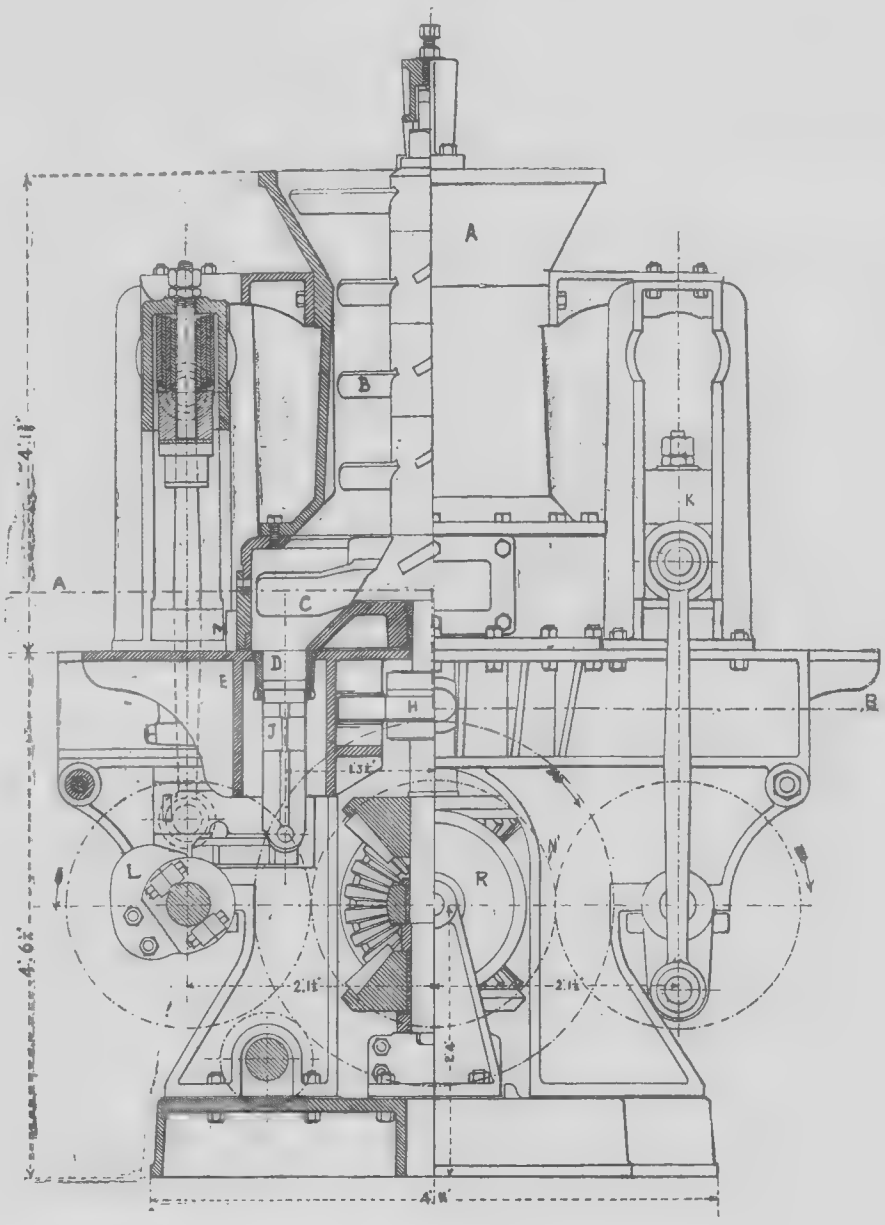


FIG 3.

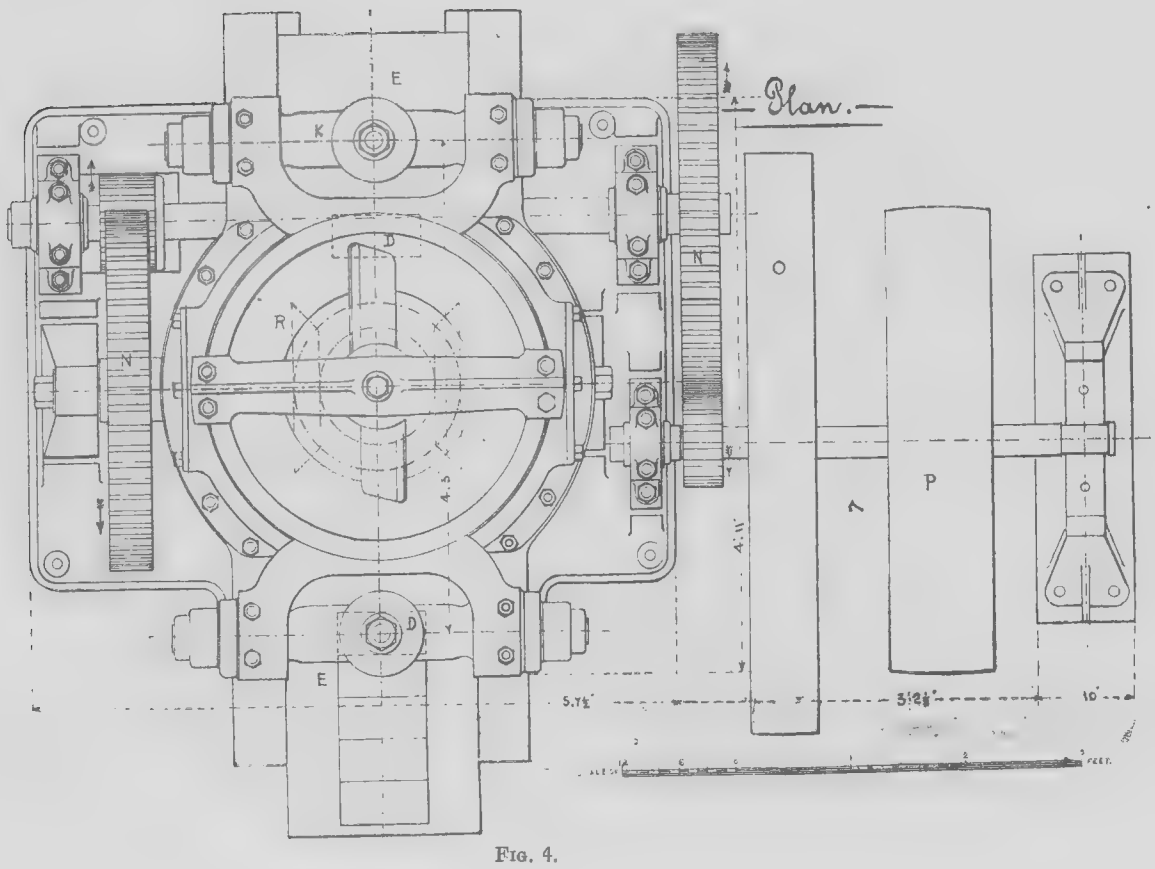


FIG. 4.

Buchanan's Brick and Tile-making Machine.

WE illustrate on pages 233, 236, and 237, an improved brick-making machine, constructed by Messrs. James Buchanan and Son, engineers, Liverpool. Several sets of these machines have recently been shipped to South America, having been proved specially suited to the clay of that country.

This machine embodies all their latest improvements for making from clay or earth the best class of bricks, sufficiently hard and stiff to go direct to the kiln without previous drying, and which when burnt have all the advantages of plastic-made pressed bricks.

The plant consists of two "Invincible" brick machines, two clay elevators, and two pairs of vertical engines and boilers.

Fig. 1 is a perspective view of the machine, and Figs. 2, 3, and 4 are elevations and plan of the machine, Figs. 5, 6, and 7 being elevation, sectional elevation, and plan of the engines and boiler. As will be seen from the illustrations, the brick machine is a very compact and massive structure, self-contained on its own bedplate. It combines in its working all the processes of mixing, pugging, moulding, pressing, and delivering the finished brick or tile.

The machine consists of a vertical pug-mill A, into which the clay or earth is fed from the elevator. It is made conical in shape, being widest at the bottom, in order to allow of the clay being forced down more rapidly and to prevent it from being carried bodily round by the knives without being pressed down, as it is apt to be if the barrel is a plain cylinder. Vertical strips are cast on, round the inner circumference, which effectually prevents the rotation of the clay.

The centre shaft, made of steel and of large diameter, is provided with cast-steel

THE "INVINCIBLE" BRICK AND TILE-MAKING MACHINE

MESSRS. JAMES BUCHANAN AND SON, ENGINEERS, LIVERPOOL.

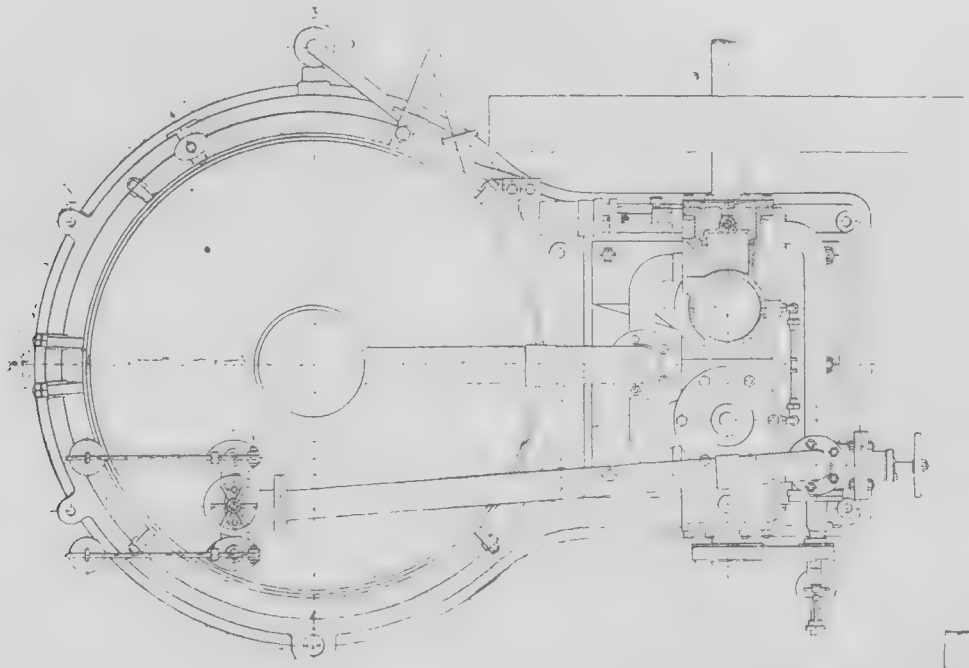


Fig. 7.

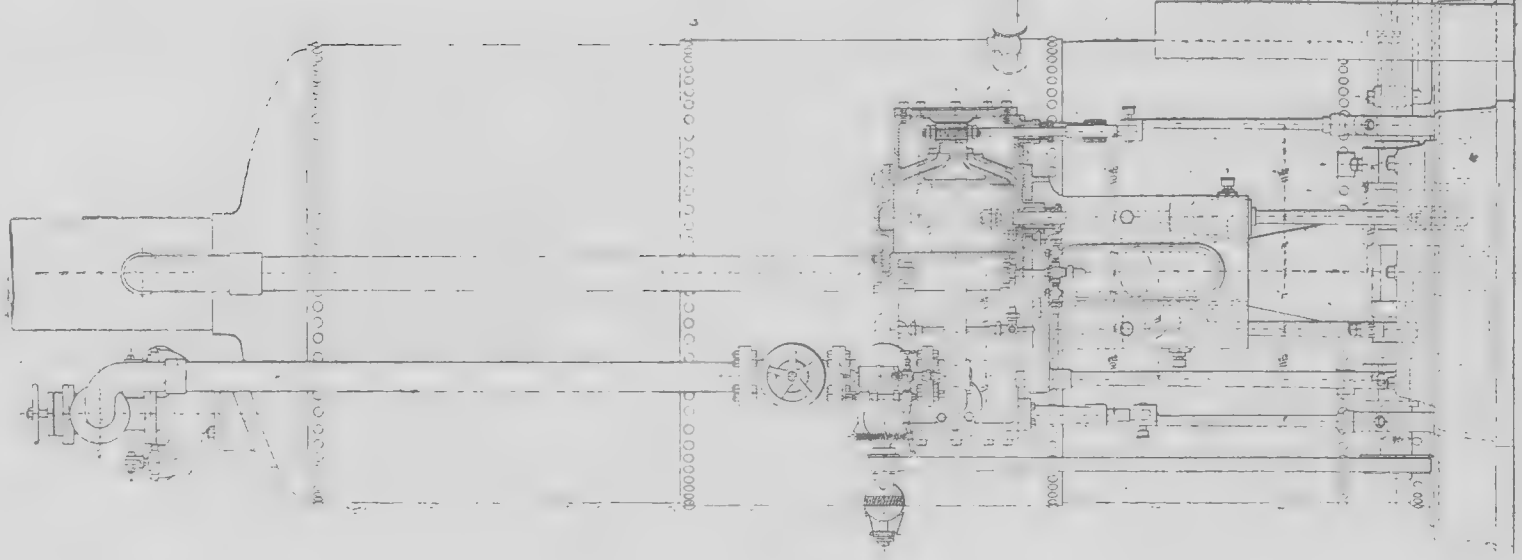


Fig. 6.

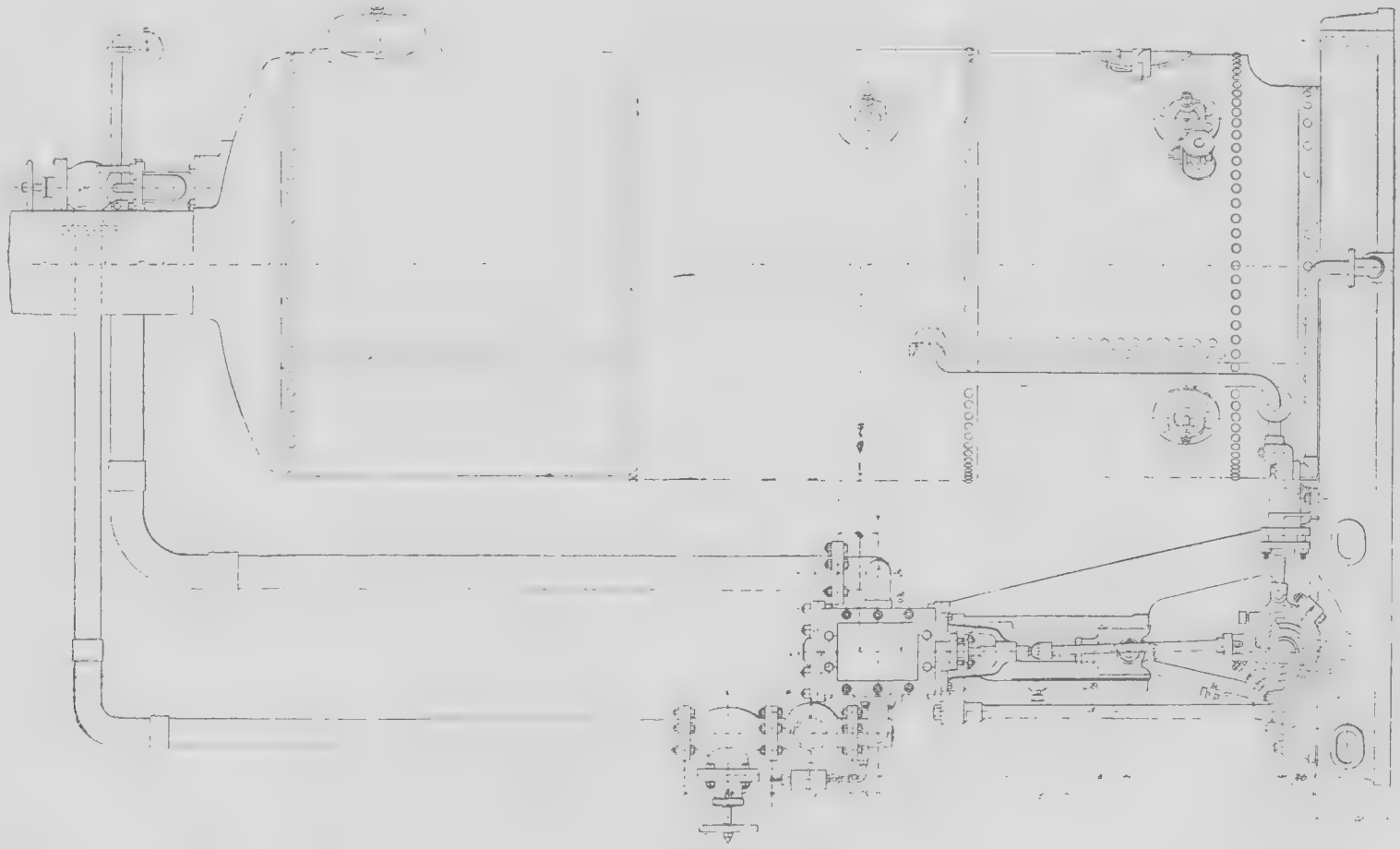


Fig. 5.

pugging knives B. The bottom one, C, is made large and broad, and forms the filling knife for the dies. In the base of the pug-mill are cast two openings at opposite sides, of sufficient size to contain the proper quantity of clay to form the brick. Under the pugmill base are placed the sliding tables E E, containing the dieboxes, which are alternately pushed backwards and forwards by the rotating cam H. In these tables are fitted the die boxes D, of the required shape and depth, and having in them plungers J which rest, when being filled, on brackets fixed to the side frames. At each end of the machine is a cross-shaft, on which is keyed the cam L, connected by means of side rods to the top crossheads K, between which and the lower plunger the brick is pressed as the tables come between the respective plungers at each end of the machine. The crossheads are guided in vertical guides attached to the side frames at the bottom, and to the pug mill at the top.

The machine is driven by means of powerful double spur gear, of crucible cast steel. The second motion pinion gears into the large spur wheel N on the cross-shaft, as shown. This spur wheel N is keyed on to the boss of the mitre wheel R, both running loose on the shaft. On the other end of the shaft, keyed on to the boss of a similar mitre wheel, is the spur wheel N^1, which drives the cam and top crosshead for one end of the machine, while a similar wheel on the other side drives the opposite cam and crosshead. The mitre wheel R transmits its motion to the top mitre wheel, which is fixed on the pugmill shaft, and to the lower mitre, which runs loose. By this means the pugmill shaft and spur wheel N are driven through the nest of mitres, and the stress distributed equally through all the wheels.

The operation of the machine is as follows:—The clay, being fed into the hopper over the pugmill, is gradually forced downwards, by the action of the pugging knives, to the bottom, when it is swept into the diebox D — which is immediately under — by the bottom knife C as it travels round. At the same moment the clay in the diebox in the opposite table is receiving its compression. As the pugmill shaft continues to revolve, the cam H pushes the table E outwards, and as both tables are rigidly connected by through bolts, the opposite table is moved inwards with it towards the pugmill base. When the table reaches the end of its stroke, the bottom plunger J is brought over the centre of the crankshaft, and is supported on the cam L, as shown in Fig. 3, end view.

As the camshaft revolves, the crosshead K is drawn down until it enters the diebox, while the bottom cam at the same time raises the bottom plunger a sufficient amount to give a simultaneous nip on the underside with the top crosshead. The cam H is so constructed that the table is held at rest and prevented from moving out of position for about one-third of a revolution, thus obviating any danger of its shifting when the top plunger enters the diebox.

The brick, during the period of compression, receives two distinct pressures or nips; the shaft continuing to revolve, the crosshead ascends, and the toe of the cam raises the bottom plunger to the top, when the table recedes under the pugmill and pushes the brick off on to the front part of the table, from which it is removed by the attendant; meanwhile, the diebox in the opposite table has been filled and brought under its plungers, and the operation is then repeated, a brick being formed alternately at each end of the machine. The crossheads K are provided with powerful springs, placed over the top plungers, and drawn up by strong bolts to give the necessary pressure on the brick required by the material. Any excess pressure over that required, due to stones or other foreign substances, will cause the springs to yield, and so relieve the machine of undue stresses.

The pugmill is provided with a bridge piece at the top to steady the shaft, and has suitable doors to render the interior accessible when necessary. A complete lubricating arrangement is supplied with each machine; all the shafts are of best gun steel, and the gearing of crucible cast steel, to withstand rough usage.

All the important working parts are made adjustable for taking up wear. The machine is constructed to work almost all kinds of clay, earth, or marls, and can be adapted for making briquettes from small coal. The elevators for these machines have been specially designed for lifting the clay, and can be started and stopped independently of the machine.

The engines for driving these machines are of the vertical inverted cylinder type, of neat and compact design. The cylinders are 5½in. diameter by 12in. stroke, bolted together and mounted on a massive cast-iron back standard, cast in one with the bedplate, and supported at the front by two wrought-iron pillars.

The steam branches are 2in. diameter, exhaust 2½in. diameter, steam ports 5½in. by ⅝in., exhaust ports 5½in. by 1½in., piston rods 1½in. diameter steel. The connecting rods are of the marine-ended type, 2ft. 3in. long, 1¼in. diameter at crosshead end, and 2in. at crankpin end.

The crosshead end is fitted with adjustable brasses. The crosshead pin is of steel, 1⅝in. diameter by 2¼in. long; the crosshead slipper is 7½in. long by 4in. wide; crankshaft bearings are 3¼in. diameter by 6in. long; fly-wheel 5ft. diameter by 7in. wide, and weighs about 15cwt.; driving pulley, 4ft. diameter by 11in. wide. The engine runs at 156 revolutions per minute, equal to a piston speed of 312ft. per minute, the maximum horse-power indicated being about 60 when carrying steam nearly full stroke.

The boiler is of the ordinary vertical cross-tube type, 4ft. 9in. diameter by 12ft. 6in. high, having four cross tubes, and constructed of mild steel plates for a working pressure of 80lb. This plant is very complete in every detail, and, as will be seen, is neatly designed and very substantial in construction.

Scotch Shipbuilding in November.

THE state of matters disclosed by the returns for the penultimate month of the year, says the "Glasgow Herald," is unmistakably better than it was a few weeks ago. That, of course, is not saying much, for in October the industry was as dull as it well could be; but even a slight forward tendency is better than the wearisome retrogression which has marked the whole year. And the improvement is of the slightest, reaching very near the vanishing point, as a matter of fact, when the circumstances from which it emerges are taken into account. A comparatively large quantity of new work has certainly been placed, and much—as proportions go nowadays—is still in the market, but in the depressed state of trade generally the revival is unnatural, and none but the poorest prices can consequently be obtained. Vessels ordered now for delivery in the early summer can only deepen the depression in the shipping trade, and help to postpone the legitimate revival, with its fairer prices, which must come sooner or later. Additions to the world's shipping are at the moment not only unnecessary, but undesirable, and the demand which November has witnessed, and December may also see, is merely the expression of a desire for ships at the lowest possible prices. How well the times suit those whose wishes lie that way may be inferred from the fact that prices were probably never lower than they are now. During the month Scotch shipbuilders launched 26 vessels, aggregating 25,207 tons, of which 17, of 17,647 tons, were steamers, and nine, of 7560 tons, sailing vessels. To the total the Clyde contributed 13 steamers, of 11,412 tons, and nine sailing vessels, of 7560 tons; the Forth, a steamer of 1200 tons; the Tay, two steamers, of 4885 tons; and the Dee, a trawler, of 150 tons.

The Value of the Steam Jacket.

(*Continued from page* 225.)

Feed Water.—The feed-water was taken from the pumping main, and was measured in two feed-measuring tanks, each holding 120 gallons. Before the experiment commenced the tanks were carefully gauged by measuring water into them from a standard measure. The feed water was pumped into the boiler through an economiser, the pump being supplied from one tank whilst the other was filling. All the feed pipes were exposed to view.

In the first day's trial, when steam was admitted into the jackets, it was discovered shortly after the commencement that a little water was passing the safety valve of the economiser. At 1 p.m., or exactly two hours after the commencement, measurements were begun to be made of this leakage, all the water that leaked past the valve being carefully collected and weighed. The leakage was found to be at the rate of 248lb. per hour, so that 496lb. has been taken as representing the leakage during the first two hours of the trial when the escaping water was not collected. The whole leakage from the commencement of the trial until the leak was stopped was thus 957lb., which has been deducted from the whole quantity that passed through the measuring tanks, in order to arrive at the total feed water supplied to the engine. The mean temperature of the feed water was 49·3° F.

In the second day's trial, when no steam was admitted into the jackets, there was no leakage of any kind.

On its way to the engine the feed-water was made to pass through a meter, which was used to obviate the possibility of any error that might arise in counting the number of feed tanks. The reading of this meter was noted every twenty minutes.

Jacket Water.—The discharge pipe from the water trap of each set of jackets was made to deliver into a separate bucket, and the weight of water in each bucket was determined from time to time by weighing on a sensitive weighing machine. The amount of water obtained from each set of jackets was thus determined separately. It was possible to test from time to time whether or not the jackets were perfectly drained, as the water traps passed a little steam if the drain pipes were open too much, and great care was taken to get all the jacket water out without wasting any steam. The following shows the quantities of jacket-water condensed in the various jackets during the first day's trial:—

Packets.	Condensed Water from Jackets.		
	During Trial.	Per Hour.	Per Minute.
	lb.	lb.	lb.
High-pressure cylr.	895	111·9	1·87
Intermediate ,,	587	73·4	1·22
Low-pressure ,,	418	52·2	0·87
Total jacket water	1900	237·5	3·96

Measurement of Pressures, etc.—Every twenty minutes readings were taken of the pressure gauges on each of the jackets, on each of the valve chests, on the boiler, on the condenser, and on the pumping main. Indicator diagrams were taken from each end of each cylinder every quarter of an hour. The reading of the counter was taken every twenty minutes. During each day's trial, therefore, the gauges and the counter were each read twenty-five times, and thirty-three sets or 198 single indicator diagrams were taken. The following table gives the average mean effective pressure and indicated horse-power in each of the three cylinders throughout both of the trials:—

	Mean Effective Pressure. lb. per sq. in.		Indicated Horse-power.	
Date of Trial, 1889	7 Dec.	6 Dec.	7 Dec.	6 Dec.
Jackets with or without Steam	Without.	With.	Without.	With
	lb.	lb.	I.H.P.	I.H.P.
H.P. cylr...	56·24	40·69	57·7	41·6
I.M.P. ,, ..	12·42	14·08	37·5	42·3
L.P. ,, ..	5·27	6·39	44·8	54·1
Total....	16·46	16·30	140·0	138·0
	(reduced to L.P. cylinder.)			

Boiler.—Steam was supplied by an externally-fired water-tube boiler made by the Babcock and Wilcox Company.

Coal.—Large and small Welsh coal, mixed in as nearly as possible equal proportions, was used throughout both of the trials. On 6th December, when steam was admitted into all the jackets, the total coal used was 2217lb., less 236lb. of clinker and ash formed during the experiment, or 1981lb. net. On 7th December, when no steam was admitted into any of the jackets, the total coal used was 2580lb., less 235lb. of clinker and ash, or 2345lb. net. These are equivalent to 247 6lb. per hour, or 4·13lb. per minute with steam in jackets, and 293·1lb. per hour, or 4·88lb. per minute without.

No. 44. Experiment on a compound horizontal engine at the Royal Arsenal, Woolwich, by Lieut.-Col. English, Mr. Henry Davey, and Mr. Bryan Donkin, jun.

Engine.—This experiment was made on a compound horizontal surface-condensing engine, driving the saw-mill in the carriage department at the Royal Arsenal, Woolwich. The engine was made by Messrs. Marshall, Sons and Co., of Gainsborough. The diameters of the cylinders are 18in. and 32in. The stroke of each cylinder is 48in. The piston rods and tail rods are all 3½in. diameter. The air pump was originally driven from the tail rod of the low-pressure cylinder by means of a bell-crank lever, but previous to this experiment it had been disconnected and was driven by a separate engine. At the same time the original jet condenser had also been removed and a surface condenser substituted for it. Each of the two cylinders has four valves, two for steam admission and two for exhaust, and each pair of valves is driven by a single eccentric. The admission valves are of the double-beat type, provided with Proell's automatic expansion apparatus, for varying the cut-off automatically. The exhaust valves are cylindrical, and of the Corliss type. The two cylinders are placed side by side, with their centres 12ft. apart.

The intermediste receiver and the bodies of both cylinders are jacketed, the cylinders forming liners in the body jackets. The ends of the cylinders are not jacketed. The receiver jacket was not in use during the experiment. The steam supply to the cylinders usually passes through the jacket on its way to the valve chests, but in order to allow of the jacket water being measured during the trial, the ordinary steam connections were removed and special steam pipes substituted. By this means, during the trial with steam in jackets, steam was supplied to the jacket of the high-pressure cylinder by a separate pipe connected with the main steam pipe on the boiler side of the stop valve; and to the jacket of the low-pressure cylinder by a separate pipe from the receiver. The jacket water from the two jackets and the drain water from the receiver were discharged and collected separately by means of drain pipes and water traps. An air cock was placed at the highest point of each jacket.

The following shows the areas of the jacketed and unjacketed portions of the inner surfaces of the cylinders, exclusive of passages:—

Cylinder.	Area of Inner Surface.		
	Jacketed.	Unjacketed.	Total.
H.P.—	sq. ft.	sq. ft.	sq. ft.
Body....	18·84	—	22·37
Ends....	—	3·53	
Per cent.	84·2 p.c.	15·8 p.c.	100·0 p.c.
L.P.—			
Body....	33·51	—	44·68
Ends....	—	11·17	
Per cent.	75·0 p.c.	25·0 p.c.	100·0 p.c.

Details of Experiment.—The experiment consisted of two trials which were made at the Royal Arsenal, Woolwich, on the 15th March and 17th May, 1890, by Lieut.-Colonel English, Mr. Henry Davey, and Mr. Bryan Donkin, jun. In the first trial, made on 15th March, and lasting for 5·97 hours, no steam was admitted to any of the jackets. In the second trial, made on 17th May and lasting for 5·57 hours, steam was admitted to the jacket of the high-pressure cylinder at a little under boiler pressure, and to the jacket of the low-pressure cylinder at a pressure of about 10lb. per square inch above atmosphere. The arrangement of steam-supply piping to cylinders and all the other conditions were maintained as far as possible the same throughout both of the trials. Steam was not admitted to the jacket of the receiver during either of the trials.

Owing to the special arrangements of steam piping which had to be made to permit of the jacket water being measured, and the consequent increase of radiating surface, no doubt the efficiency of the engine was somewhat reduced. As this, however, applies equally to both of the trials, the percentage saving due to the two steam jackets as determined by these two trials is probably little affected by this. From another trial made on the same engine, but not here recorded, the increased saving in feed water due to the use of the receiver jacket with boiler steam, in addition to the other two jackets supplied as in the foregoing trial, was found to be 1·7 per cent., or a total saving due to the three jackets of 19·0 + 1·7 = 20·7 per cent.

Feed Water.—On its way to the boiler the feed water was passed through tanks in which it was weighed. In the trial without steam in any of the jackets, the total weight of water pumped into the boiler in 5·97 hours was found to be 16,268lb., which is at the rate of 2725lb. per hour, or 45·4lb. per minute. This is equivalent to 7·59lb. of feed water per lb. of coal. In the trial with steam in the two cylinder jackets, the total weight of water pumped into the boiler was found to be 12,622lb. in 5·57 hours, which is at the rate of 2267lb. per hour, or 37·8lb. per minute. This is equivalent to 7·51lb. of feed water per lb. of coal.

(*To be continued.*)

MR. ALEXANDER BROGDEN, a retired iron-master, and formerly M.P. for Wednesbury, died on the 26th ult. under distressing circumstances. On the 23rd ult. he was sitting by the fire, and, in attempting to stir it, he fell forward against the grate, receiving severe burns, to which he succumbed. Mr. Brogden, who was 67 years of age, was born at Manchester.

Metal Trade Memoranda.

The export of gold from Cape Colony during the month of November amounted to £439,256, compared with £250,000 in the corresponding month of last year.

The second portion of the Pelsall Ironworks sale realised over £7000, making a total for the two sales of nearly £14,000. Before being broken up, the whole concern could have been bought for £10,000.

Circular letters have been issued announcing the completion of the purchase by Messrs. Williams, Foster and Co. Limited, Swansea, of Pascoe, Grenfell and Sons' Copper Works at Mideele and Upper Bank, Swansea. The price is £40,000.

The return of the Midland Iron and Steel Wages Board shows that the average selling price of iron during the months of September and October was £6 7s. 2d. a ton, or a reduction of 5d. per ton only as compared with the previous two months. This leaves ironworkers' wages unaltered.

According to the monthly statistics issued by Messrs. H. R. Merton and Co., the stocks of copper in England and France, and afloat thereto from Chili and Australia, declined last month from 56,078 tons to 53,498 tons. The deliveries were 10,017 tons, against 8990 tons in October, whilst the supplies from all sources amounted to 7437 tons against 6586 tons.

The report of Mr. Waterhouse in connection with prices and wages in the Northern manufactured iron trade, presented to the Conciliation Board, shows increasing depression, the production of rails, bars, plates and angles for September and October (33,000 tons) not much exceeding half the output during the time of brisk trade three years since. The net average price (£5 6s. 9d.) is 8d. decline, the reduction this year being 4s. per ton. Ironworkers' wages were reduced 2½ per cent. two months since, but remain unchanged for the next two months by the sliding-scale.

On the 3rd inst., the November returns of the Cleveland Ironmasters' Association were issued at Middlesbrough, showing an increase of 3998 tons as compared with an increase of 16,914 tons for October and 7161 tons for September. The total production was 233,574 tons of pig iron of all kinds, compared with 237,063 tons in the previous month, the difference being due to there being one day less. Forty-nine furnaces are working on Cleveland iron, and 46 on hematite spiegel and basic iron, one furnace more being engaged in producing the latter class of iron than in October. The increase of stocks brings the total quantity of iron now in makers' hands and in warrant stores to 74,181 tons. The stock at the end of November last year was 254,276 tons, the great reduction being due to the Durham strike stopping furnaces for some months.

Trade Marks.

The following is the Official List of Applications published from November 23 to November 30 for the Registration of Trade Marks, so far as relates to the Metal Trades.

CLASS 50.

PAROLINE

167,597. Asbestos packing, belt composition, brattice cloth, compositions for extinguishing and preventing fires, compositions for indurating leather, enginepacking, hydraulic packing, steam packing, roofing felt, rope, jute, and hemp, and hose of all kinds, being goods included in Class 50. HARRY GORDON SMALL AND GEORGE WILLIAM PARKES, trading as SMALL AND PARKES, Cable Mills, Glasshouse-street, Manchester; engine packing manufacturers.—8th October, 1892.

The Metal Market.

PRICES CURRENT.

LONDON, DEC. 5.

COPPER was easy and 3s. 9d. lower, with cash at £47 12s. 6d. when trading commenced, and three months passed at £48 1s 3d. The market subsequently showed a firmer tone on good support, but again became easy in the afternoon, when £47 12s. 6d. and £47 11s. 3d. were taken for middle of January, £47 15s. and £47 13s. 9d. for middle of February, and £47 16s. 3d. for three months, and on the kerb cash declined to £46 6s. 3d., the close being easy at a loss of 10s. on the day. The decline is due to a lack of confidence, which has induced outside speculators to realise. Sales, 800 tons. Settlement price, £47 7s. 6d. English tough, £51 10s. to £51 15s.; best selected, £52 to £52 10s.; strong sheets, £60.

TIN opened steady at 7s. 6d. reduction, three months passing at £92 10s., and later the price sharply dropped to £92 5s. on holders clearing out consequent upon the unsettled state and prospects of the silver market and a growing disposition to take profits. Later on cash made £92 7s. 6d., but further weakness followed on renewed selling, three months declining to £92, and in the afternoon two months was realised at £91 17s 6d. The close is flat, with values 17s. 6d. below Friday's final rates. Sales, 150 tons. Settlement price, £92. English ingots, £95 10s.

PIG IRON began with 41s. 9d. bid for Scotch, cash, and later on there was a buyer of one month at 42s. 1½d. Holders, however, looked for higher prices and missed their market, values dropping to 41s. 10s. cash and 42s. 0½d. one month in the afternoon, but without inducing business. Settlement prices: — Scotch, 41s. 10d.; Middlesbrough, 37s. 4d.; hematite, 46s.

TINPLATES dull and unchanged. I.C. cokes, f.o.b. London, 12s. 9d.; Liverpool, 12s. 3d.; Swansea, 11s. 9d.

LEAD is easier, being freely offered at £10 1s. 3d., but there is little inquiry. English, £10 5s.

SPELTER is 1s. 3d. easier at £18 16s. 3d. sellers, December shipment. Silesian specials, £19 to £19 2s. 6d.

ZINC SHEETS.—Silesian ordinary are dull and 2s. 6d lower at £21 17s. 6d sellers, ex-ship. Belgian quiet, but steady; V.M. brands, ex-ship, £22 5s., f.o.b.; Antwerp, £22.

ANTIMONY is offered at £44 10s. ordinary marks.

QUICKSILVER quiet but steady at £6 10s. from first, and £6 8s. 6d. to £6 9s. from second hands.

OFFICIAL CLOSING QUOTATIONS.

	£	s.	d.	£	s.	d.
COPPER—						
G. M. B.—Cash	47	7	6	47	15	0
„ Three months	47	16	3	48	3	9
English tough	—			—		
Best selected	—			—		
Strong sheets	—			—		
TIN—						
Fine foreign—Cash	92	0	0	92	10	0
„ „ Three months	91	17	6	92	7	6
Australian—Cash	92	10	0	93	0	0
PIG IRON—					s.	d.
Scotch warrants—Cash					41	10
„ One month					42	0½
Middlesbrough—Cash					37	4½
„ One month					—	
Hematite—Cash					46	0
„ One month					—	

GLASGOW, Dec. 5.—Business was very quiet on the pig iron market. About 9000 tons of Scotch were dealt in, some lots changing hands several times. Owing to the favourable character of the Cleveland returns the cash price rose at one time 1½d. Cleveland was quoted at 3d up, but there were no transactions; but hematite was easier. The shipments of Scotch last week reached 4919 tons, being a decrease of 494 tons on the corresponding week, reducing the increase for the year to 23,949 tons.

QUOTATIONS.

	Highest.		Lowest.	
	s.	d.	s.	d.
Scotch warrants—Cash	41	10½	41	10
„ One month	42	0½	42	0½
Middlesbrough—Cash	37	4½	37	3
„ One month	—		—	
Hematite—Cash	46	0	46	0
„ One month	—		—	

New Companies.

AUTOMATIC ELECTRIC RAILWAY SIGNAL COMPANY LIMITED.—This company was registered on the 20th ult. with a capital of £10,000, divided into 1000 shares of £10 each, to acquire patents and apparatus for railway signalling, and articles of a similar nature appertaining thereto; to enter into a certain agreement, duly specified, and to establish and work automatic electric signals for railways, and grant licences to establish and work the same. Registered by Messrs. Holme and Wynne, 40, Chancery-lane, solicitors.

SOUTHALLS MACHINERY SYNDICATE.—This company was registered on the 30th ult., with a capital of £6000, divided into 6000 shares of £1 each, to take over and adopt an agreement dated November 22, 1892, made between Messrs. C. H. Southall and R. H. Southall, of the one part, and Mr. F. A. Holdworth for and on behalf of the syndicate, on the other part, to acquire patents, inventions, rights and privileges in connection with paring the heels of boots, paring the soles of boots, etc. Registered by Waterlow Bros. and Layton Limited, 24 and 25, Birchin-lane, E.C.

UNITED KINGDOM ECONOMIC GAS SYNDICATE LIMITED.—This company was registered on the 29th ult. with a capital of £10,000, divided into 10,000 shares of £1 each, to adopt and carry into effect a certain specified agreement, being for the sale to and purchase by the company of certain inventions in the behalf mentioned, and the letters patent and other rights obtained in respect of the same; and to carry on the business of ironfounders, mechanical engineers, and manufacturers of tools, implements, and other machinery. Registered by Mr. William Hicks, 13, Old Jewry Chambers, E.C.

EDISON-BELL PHONOGRAPH CORPORATION LIMITED.—This company was registered on the 30th ult. with a capital of £60,000, divided into 12,000 shares of £5 each, to enter into and carry into effect a certain specified agreement, and to apply for, obtain, or otherwise acquire any inventions, letters patent, etc., for, or in relation to, phonographs and graphephones, telephones, or any combinations thereof, and to the recording and reproduction of speech and other sounds; and to carry on the business of electricians, electrical, mechanical, metallurgical, and chemical engineers. Registered by Messrs. Ashurst, Morris, Crisp, and Co., 17, Throgmorton-avenue, E.C.

ELECTRIC AND GENERAL CONTRACT CORPORATION LIMITED.—This company was registered on the 25th ult., with a capital of £50,000, divided into 10,000 shares of £5 each, to enter into and acquire, by purchase or otherwise, and carry out contracts or concessions or other grants in any part of the world, for making, or purchasing, or working railways, tramways, telegraph and telephone lines, electric and other lighting, electric, hydraulic, and other works, and for equipment of any such undertakings or works with electric or other plant, stock, and apparatus, and generally to carry on the business of general contractors in any part of the world. Registered by Mr. Clarence Leighton, 12 and 13, Clement's Inn, W.C., solicitor.

Official Gazette.

Partnerships Dissolved.

MINNS and LAWSON, Victoria-street, Westminster, and Stroud, Gloucestershire, civil engineers.

J. T. WOODHAM, W. SMITH, and C. H. FUESSLI, under the style of Woodham, Smith and Co., Manchester, electrical engineers and contractors; as far as regards C. H. Fuessli.

L. G. LAURI and E. JOHN, under the style of Lauri and John, Barry Dock, engineers, boilermakers, and ship repairers.

H. CREMER and S CHEELD, under the style of Cremer and Cheeld, Chesham, mechanical and electrical engineers.

THE BANKRUPTCY ACTS, 1883 AND 1890.

Receiving Orders.

R. W. UHLICH, trading as [illegible] Whittington-avenue, Leadenhall-street, City, and Weston-park, Crouch End, Hornsey, metal merchant.

H. BARRATT, Northampton, engineer.

I. BROWN, trading as John Brown, South Hylton, near Sunderland, rivet manufacturer.

A. KEEN, Canterbury, blacksmith.

R. B. MILLS, Ketteri[illegible]g, machinist.

J. WALL, Birmingham, machinist and engineer.

Adjudications.

R. W. UHLICH, trading as R. Uhlich and Co., Whittington-avenue, Leadenhall-street, City, and Weston-park, Crouch End, Hornsey, metal merchant.

H. BARRATT, Northampton, engineer.

W. JACKSON, Walsall, vice maker.

W. JOHNSON, King's Heath, Worcestershire, late Shirley, Warwickshire, King's Norton, Hopwood, and Birmingham, late metal roller, then commercial traveller, now out of business.

A. KEEN, Canterbury, blacksmith.

J. WALL, Birmingham, machinist and engineer.

Letters to the Editor.

*** *We do not hold ourselves responsible for opinions expressed by correspondents.*

*** *The name and address of the writer (not necessarily for publication) must in all cases accompany letters intended for insertion, or containing queries.*

*** *Letters intended for publication in the current week's issue must reach our Manchester Office not later than by the first post on the Tuesday preceding the date of publication.*

ROLLER FLOUR MILLING.

To the Editor of THE MECHANICAL WORLD.

SIR,—If the articles which are now appearing in your columns have only just been delivered into your hands, I am compelled to say that the writer is decidedly not up to date in his remarks and knowledge concerning wheat-washing machinery, for, if I remember rightly, there was exhibited at the Warwick Show, by Messrs. Dells, of Mark-lane, London, a new form of wheat-washer and stoning machine, which had the distinct advantages of large capacity, occupying small space, and effectually carrying on automatically the washing of wheat, and separating stones, mud balls, and shrunken wheat from same. I enclose you an illustration of the machine, which is made with two cylinders. The insides of these are made so as to act as internal worms. The operation of the machine is roughly this:—The dirty wheat is fed into the machine at the head end, accompanied by a stream of water entering through another channel. Having found their way into the cylinder, the heavy bodies fall to the bottom, and are wormed by the cylinder itself to the head end of the machine, where they fall through a spout fixed to the cylinder, whilst the wheat and water is travelling on to the tail end of the machine, from which they are spouted into a tank of fresh water. In this the shrunken wheat and light bodies rise to the top of the water and float over an overflow spout (which also acts as a receptacle for carrying off waste water) attached to the side of the tank. Regulators are provided for the water entering the cylinder, and also for clearing the tank, whilst an arrangement is provided for regulating the feed of the wheat.—Yours, etc.,

London. PENKNIFE.

Prize Competition.

WE OFFER FOUR GUINEAS MONTHLY IN PRIZES FOR THE BEST ORIGINAL ARTICLES SENT IN ON ANY MECHANICAL, ENGINEERING OR ELECTRICAL SUBJECT.

IN ORDER THAT MANAGERS, DRAUGHTSMEN, FOREMEN, AND WORKMEN WHO HAVE HAD NO PRACTICE IN WRITING MAY NOT HESITATE TO SEND IN COMPETITIONS, IT IS TO BE UNDERSTOOD THAT ALL ARTICLES WILL BE FULLY EDITED AND CORRECTED, AND JUDGED OF SOLELY ON THEIR MERITS AS ORIGINAL CONTRIBUTIONS FROM A PRACTICAL POINT OF VIEW. THE OBJECT OF THE COMPETITION IS TO INDUCE PRACTICAL MEN TO COME FORWARD AND GIVE THE RESULTS OF THEIR EXPERIENCE.

CONDITIONS.

Competitions for our Monthly Prizes must be sent so as to arrive at the Manchester Offices of THE MECHANICAL WORLD, New Bridge-street, not later than the last Tuesday in each month. Articles arriving after that time will be placed in the following month's competition.

Written competitions must be on one side of the paper only. The contributions must be original, and relate to matters connected with Engineering, Mechanism or Electricity.

The Proprietors of THE MECHANICAL WORLD reserve the right to publish any competition, whether it gains a prize or not.

The competitions may be accompanied by diagrams' sketches or drawings.

Competitors should write the words "Prize Competition" on the envelopes.

Competitors are not confined to one, but may send any number of competitions.

The correct name and address of the sender must be distinctly written upon every competition, not necessarily for publication. Competitions can appear under a *de plume*.

☞ We cannot undertake to be responsible for any MSS. sent to us, though when stamps are enclosed for the purpose we will endeavour to return rejected contributions.

Miscellaneous Items.

It is claimed for the new magnesium flash light for lighthouses, introduced experimentally in Germany, that its ability to penetrate a dense opaque atmosphere exceeds that of any other known light.

A large clock, with dials 11ft. in diameter, has been presented to the city of Liverpool. The clock also drives three large dials inside the University building by an electrical arrangement attached to the works.

An artesian bored tube well, 144ft. in depth, has recently been drilled at Leighton Buzzard, tapping powerful springs, yielding a minimum supply of 290,000 gallons per day for the supply of the town, without materially affecting the head of water.

Fifty tons of barnacles, it is stated, have been removed from the bottom of H.M.S. "Northampton," the flagship of the Nore. During the naval manœuvres this vessel would only steam about three and a half miles per hour, whereas her correct speed is over thirteen knots per hour.

A scheme is under consideration in the town of Aalesund, on the north-west coast of Norway, for the purchase of an estate and a waterfall, situated about five miles from the town, with a view to the establishment of an electric station worked by water-power. It is said that the river in question never freezes in winter.

It is announced by the Ottoman Railway of Anatolia that the first locomotive to traverse the entire line arrived in Angora on the 22nd ult. The construction of the final sections of the railway being now practically completed, it is expected that they will be formally opened for public traffic by the end of the year.

It is intended to establish telephonic communication between Frankfort-on-the Maine and Berlin. It is said that two wires will be arranged for direct communication between both towns and two others for the intermediate towns of Giessen, Cassel, etc. According to the scheme, the direct lines are to be in operation at the commencement of next year.

The annual social meeting of the staff connected with the firm of Meldrum Bros., engineers, Manchester, took place on Saturday last, at the Trevelyan Hotel, Manchester. In the absence of the senior member of the firm through sickness, the chair was occupied by Mr. T. F. Meldrum, who, in replying to the toast of "Success to Meldrum Bros.," referred to the previous steady progress of the concern, and held out an encouraging prospect for the future. The usual votes of thanks closed a most enjoyable evening.

Shipbuilding will be one of the chief features of the British collection at the forthcoming Chicago World's Fair, and the Clyde will be specially well represented. The Fairfield Company will make a fine display of models and plans of their finest productions, including the new Cunarders. Not the least interesting part of their collection will be an immense drawing, showing the longitudinal section of these new vessels. Messrs. Thomson, of Clydebank, will have a collection, and it will probably be the most varied of any, for their high-speed battleships, cruisers, scouts, torpedo-boats, torpedo-destroyers, and merchantmen will be represented. Messrs. Denny, of Dumbarton, will have representations of their recent success; while dredger models will be sent by several Clyde firms.

The "Kew Gardens Bulletin," referring to a new variety of sugar cane which is stated to have been discovered in the Upper Niger region of Central Africa, says:—It is described as a giant variety possessing great saccharine richness, and capable of being readily reproduced from seed, which in this variety is well developed. Several inquiries have already been addressed to Kew in regard to this cane, and it may be well to state at once that there are grounds for believing that the plant mentioned is not a sugar cane at all, but the ordinary Guinea corn or sorghum (*Sorghum vulgare*), which is widely distributed over Africa. This plant, it is well known, yields a useful syrup, and strenuous efforts are being made in the United States at the present time to extract a granulated sugar from it. Should the Niger plant prove to possess any special merits as a sorghum we shall no doubt hear more about it. It can have, however, little or no interest to the tropical sugar planter."

Mr. W. Mattieu Williams, the well-known metallurgist and popular writer on scientific subjects, died suddenly on the 28th ult., at his residence, near Willesden, in his 74th year. Mr. Williams spent his early days in London, and was apprenticed to an optical instrument maker when only 11 years of age. Inheriting a small sum of money, he removed to Edinburgh, and studied there for some time. At the foundation of the Birmingham and Midland Institute, in 1854, he was appointed master of the classes then forming the industrial department. After holding for some time the appointment of metallurgical chemist to Sir John Brown and Co.'s Atlas Works, Sheffield, Mr. Williams removed to the neighbourhood of London, and occupied himself in writing scientific works and articles, among which may be mentioned "Science in Short Chapters," a collection of short treatises on subjects with which he was most competent to deal, and a philosophical essay, entitled "The Fuel of the Sun," which created some stir in scientific circles.

Queries.

☞ Readers are invited to avail themselves of this section for practical information on questions relating to Mechanical Engineering and the Scientific Industries.

☞ Queries and Replies should arrive at the Manchester Office not later than by the first post on the Tuesday preceding the date of publication.

PLOUGH BREASTS.—Can any reader inform me the best way to grind cast-iron plough breasts?—T. W.

FILTRATION.—Will any reader state the best method of filtering 150 gallons of canal water per day for steam-boiler purposes?—T. H. MITCHELL.

SPEED OF DRIVE CHAIN.—Can any reader give me any particulars as to the safe speed at which Ewart's patent chain may be run?—SECOND MOTION.

CONVERTING GAS ENGINES.—Will any reader kindly inform me how to convert a Crossley's gas engine, 15H.P., slide-valve type, to a tube firing type?—FITTER.

SWEDISH BESSEMER STEEL.—Can any reader inform me how Swedish Bessemer steel is made, and also give highest amount of carbon it contains?—FORGEMAN.

COATING FOR WATER PIPES.—Can any reader tell me how to ascertain whether cast-iron pipes have been properly coated with Dr. Smith's solution?—WATER PIPE.

BLUE PRINTING.—Can any reader kindly inform me what the necessary mixture for *extra rapid* ferro-prussiate sensitising fluid is made from, and the quantities?—FOUNDRY.

"GRASS" PACKING.—Can any reader supply me with the address of manufacturers of this packing? I have seen it used for the piston and valve rods of L. and N.-W. railway engines.

SPEED OF LOCOMOTIVES.—Provided a railway line is laid as perfect as possible, can any engine attain such a velocity as to cause it to leave the rails owing to excessive speed only?—P. T. G.

TWIST DRILL CUTTERS.—Can any reader give me a method of getting the correct thickness and shape of cutter for any diameter of twist drill, straight lip? A drawing will greatly oblige.—J. M. F.

PETROLEUM.—Will any chemical correspondent kindly inform me what is the chemical constituent in petroleum that causes it generally to give off such an objectionable odour, and also by what means it is deodorised?—ODOUR.

MILLING MACHINE WHEELS.—Can any reader give me the number of wheels that should accompany a milling machine, and the number of teeth both in the smallest and largest wheels; also whether they rise by two teeth or four?—TOOLS.

FRICTION.—Could any reader tell me the difference of friction between a roller with journals of cast iron 15in. diameter working in a half bush 18in. long, and a roller with journals of steel 9in. diameter, working in a half bush 18in. long, each roller to be 30 tons.—BUSH.

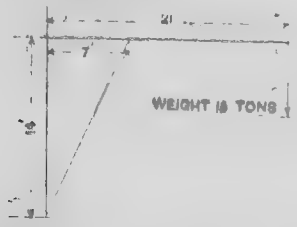
PRESSED PAPER.—I shall be obliged if any reader can furnish me with names of firms in England or abroad who press paper for making trays, wheels, teeth, etc., and the widening circle of articles now made of compressed paper or pulp.—A CONSTANT READER.

TRIPLE-EXPANSION ENGINE CYLINDERS.—Will any reader show me how to find the diameters of the H.P. and M.P. cylinders, from the following data:—Diameter of L.P. cylinder, 88in.; stroke, 5ft.; revolutions, 73; boiler pressure, 180lb.; 4500I.H.P.; cut-off in H.P. cylinder, 0·6 stroke.—W. G.

TUBE MANDRELS.—Can any reader inform me the best way to steady while turning, and also to lap when turned, a mandrel $\frac{1}{4}$in. ×7ft. long, to be lapped with $\frac{1}{1000}$ of taper in the whole length? I should also like to know the price per foot for the same.—TURNER.

LOSSES IN STEEL FURNACES.—Could any reader kindly inform me the average per cent. of actual loss, and the average per cent. of skull, in the charge of a Siemens open-hearth steel furnace working charges of from 30 to 40 tons? And also the percentage of loss in heating slabs and ingots in the Siemens regenerative gas furnace?—J. R. R.

STRESS IN FRAMEWORK.—Will any reader kindly show me how to obtain the stresses in the following diagram:—



—STATICS.

Replies.

☞ Owing to the constant increase in our correspondence, we regret that we have no alternative but to announce that we cannot reply by post to Queries even when stamped envelopes are sent.

☞ Queries and Replies must in all cases be accompanied by the names and addresses of the writers, as no notice will be taken of anonymous communications.

ASBESTOS.—"Asbestos and its Uses," by R. H. Jones, 12s. 6d., will suit you. It may be had from our office.

J. WALKER.—"Screws and Screw-making," 3s., will, we think, best answer your purpose. We can supply you with a copy.

ECCENTRIC WHEELS.—Will any reader of THE MECHANICAL WORLD inform me how to set out a pair of eccentric wheels correctly?—[illegible] S. P.—[An article on this subject will appear next week.—ED.]

[illegible]NDEER.—We are not quite clear as to your meaning. Do you wish to compare the mechanical efficiency of an engine having a ratio [illegible]ecting rod to crank of 5, with another [illegible]aving an infinitely long connecting

Z.—When you condescend to attend to our rules, and not attempt to edit this journal, your query shall be attended to. Your letter was acknowledged in our issue for NOV. 25, page 220.

PHOSPHOR.—(1.) We believe you will obtain the paint you require from Mr. R. R. Minton, Briggate, Leeds. (2.) We do not know how long it retains its luminous power. (3.) Some we have seen has stood the weather a considerable time.

C. H. B.—Parkinson's Condensed Gas Company, whose advertisement appears on the front page of this issue, will be pleased to attend to your wants. We do not know of any work treating on the preparation of oxygen. The process is rather complex.

ANXIOUS.—The iron is first cleaned by being steeped for some eight hours in water containing about 1 per cent. of sulphuric acid, then scoured with sand, washed, and placed in clean water. After this the iron is heated, immersed in chloride of zinc to act as a flux, and then plunged into molten zinc, the surface of which is protected by a layer of sal ammoniac. The process differs slightly according to the size and shape of the article. It is a simple one, and may be applied to small articles in any workshop.

MOULDING SAND.—Will any reader inform me where the fine moulding sand is obtained which is used for making small malleable-iron castings in Walsall?—IRON FOUNDER.—*A.*—Mr. John Williams, Icknield-square Wharf, will supply you.

CASTINGS.—In reply to "L. U.," the answer of "Water Meter" is misleading, as the method he mentions is used only for the purpose of securing the pieces in the metal cast round them, and no amount of "jagging" would produce clean castings. He should have the pieces "tinned," and, if possible, "skin" dry the moulds.—FOREMAN PATTERN-MAKER.

HARDENING AND TEMPERING.—Can any reader inform me how to harden and temper a number of straight steel wires 13 gauge and 16in. long? I have tried several ways, but I cannot keep them straight. I may say that I have hardened them in oil, and one at a time.—BLACKSMITH.—*A.*—Mr. E. Frost, of Hillsboro', Sheffield, will be pleased to correspond with you.

IRON MIXTURE.—Can any reader supply a mixture for steam hammer heads (chilled)?—TYRO.—(*A.*)—In reply to "Tyro" *re* chilled hammer heads, he will find the following good mixtures:—

Lilleshall .... 5 parts	Cleator ..... 5 parts
Madely Wood 2½ ,,	Hematite .... 5 ,,
Cleator ..... 5 ,,	Lilleshall (cold
Hematite .... 2½ ,,	blast) ..... 2 ,,
Chills to a depth of 1½in.	Madely Wood 2 ,,
	Chills to a depth of 1in.

—FOREMAN PATTERN-MAKER.

BOILER FOR MODEL ENGINE.—Will some reader kindly give me size of boiler for engine, horizontal, ½in. bore, 1in. stroke, engine to run at least 2 hours at each operation, boiler to be vertical?—AMATEUR.—*A.*—A boiler 9in. by 6in. will run the engine about one hour each time. This size of boiler is out of all proportion to the engine, so I would advise a boiler 6½in. by 3in. diameter, with a firebox 3in. by 3in. (without an internal firebox), put in a ¾in. central flue tube. Make the whole thing of thin sheet copper, braze all the joints, and fire by gas, and you will get lots of steam. You could attach a check valve, and have a force pump with a ⅝in. plunger to supply boiler by hand, but I do not advise attaching it to engine.—J. A.

SEA-GOING ENGINEERS.—(1.) What are the qualifications and experience necessary to become third engineer on an ocean-going steamer, passenger or merchant service? and (2) Whether it is necessary to serve in a marine engineering shop previous to going out?—MARINE.—*A.*—(1.) The qualifications and experience necessary to become third engineer in the merchant service vary so much with different companies and at different ports that a complete answer could not be given in the short space allotted. (2.) It is not absolutely necessary to serve in a marine engineering shop previous to going out, though, of course, desirable.—DRAUGHTSMAN.—Mr. F. Holroyd, 17, Salisbury Gardens, Hull, and Mr. R. L. Fryer, The Dock, Felixstowe, Suffolk, would like to communicate with you. [We hope to shortly insert an article on this subject, giving full particulars.—ED.]

Latest Inventions.

APPLICATIONS FOR LETTERS PATENT.

When Patents have been "communicated," the name of the communicating party is printed in italics.

Where complete specification accompanies application, an asterisk is suffixed.

21st November, 1892.

21,085 PICKLING METALS for GALVANISING and TINNING. A S Ramage.
21,089 APPARATUS for FOG SIGNALLING on RAILWAYS. F A Rogers.
21,093 PULSOMETERS. C Burnett.
21,095 ROPES for DRIVING. W, G H, and E Kenyon.
21,100 OIL CANS or LUBRICATORS. A Lovekin.
21,102 PULLEYS, WHEELS, DRUMS, and DISCS. A Slubbs.
21,108 ALUMINIUM. C Allen and others.
21,109 CUTTING-OFF MACHINE for CLAY BRICK-MAKING. J and E Whittle.
21,121 FIREBAR or GRATING for FURNACES. G A Newton.
21,127 RAILWAY SIGNALLING APPARATUS. L B Stevens.
21,129 FURNACES for STEAM BOILERS. T Craig.
21,133 SHADE CARRIERS for ELECTRIC LIGHT PILLARS and BRACKETS. J Taylor.
21,142 FISHPLATES for VIGNOLE RAILS.* A Wilke.
21,145 STEAM and OTHER FLUID-PRESSURE ENGINES. S Robinson
21,146 APPLIANCES for USE in FORMING CURLED OVEREDGES of SHEET-METAL ARTICLES. J F Chapman.
21,147 ELECTRIC VEHICLES for USE on ROADS. C R Garrard and T W Blumfield.
21,151 MANUFACTURE of IRISH PEAT INTO FUEL for STEAM and HOUSEHOLD PURPOSES. W and J Henry.
21,155 AUTOMATIC HEAT REGISTERING and GOVERNING APPARATUS. A Pickard.
21,162 SOLDERING ALUMINIUM. R Haddan. (*F Singer* and *H Barthel*, Germany.)
21,169 REGULATING APPARATUS for ELECTRIC ARC LAMPS. J Dulait.
21,170 TRAVELLING CARRIAGES for RAISING, LOWERING, and TRAVERSING LOADS. J Temperley.
21,171 STEAM ENGINES. M H Robinson.
21,172 STUFFING BOXES of PISTON VALVE and OTHER RODS. J C Peache and W Bashall.

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21,174 STEAM BOILERS.* E J Moore.
21,178 HOISTS. B Banks.
21,181 PISTON PACKING RINGS. J Hargreaves.
21,184 RAILWAY SIGNALLING APPARATUS. W H Parry.
21,185 STEAM GENERATOR FURNACES. J J Wilkie.
21,188 NUT-LOCKING DEVICES. T P Carswell.
21,193 PRODUCING ZINC from BLENDE by MEANS of ELECTROLYSIS.* G E Cassel and F A Kjellin.
21,195 AUTOMATIC TUBE-DRILL APPARATUS. M Blumrich.
21,197 CONE FRICTION COUPLINGS. T Rothwell.
21,198 MACHINES for CUTTING PAPER. J Whiteley and others.
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21,204 GIRDERS and SECTIONED METAL in IRON and STEEL. P Robinson.
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21,229 PLUG STOPPER or CLOSING DEVICE for TUBES or VESSELS SUBJECTED to PRESSURE.* G P Uhlenbroich. (*M Seipp*, Germany.)
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21,237 ANCHORS.* W T Honess.
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21,243 FORMING JUNCTIONS BETWEEN ELECTRIC LIGHT CABLES and ELECTRIC LAMPS. F W Webb and A M Thompson.
21,250 TOOLS for EXPANDING TUBES in the TUBE PLATES of STEAM BOILERS. E Petersen.
21,253 LIFTING JACKS.* P Jensen. (*G H Bryant* and *V Beauregard*, United States.)
21,260 SELF-SIGNALLING APPLIANCE for RAILWAYS. J Bentley and J Palmer.
21,263 RAILWAY RAILS.* P H Dudley.
21,264 APPARATUS for PRODUCING COLD. E Hesketh and A Marcet.
21,266 GAS ENGINES. A Ashby.
21,267 UPRIGHTING LATHES.* D H Church.
21,268 SUSPENSION DEVICES for ELECTRIC INCANDESCENT LAMPS.* S Porter and J R White.
21,271 TINNING IRON and STEEL PLATES.* E Norton.
21,276 FURNACES. J S Ecker and others.
21,277 INGOT MOULDS.* S T Croasdell.

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21,288 TANKS, BATHS, and CISTERNS WITHOUT RIVETS in the BODIES. D P Menzies.
21,291 UTILISATION of SEWAGE. A O Jones.
21,296 BUILT CRANK SHAFTS. T T Laidlaw.
21,298 SOLDERING FLUX or ACID. A McKenzie.
21,302 MANDREL or FORGING TOOL USED in the MANUFACTURE of BUCKLES for VEHICLE SPRINGS.* Messrs. Steel, Peach and Tozer Limited and S Oates.
21,305 DRIVING GEAR of LATHES. W Hudson.
21,307 SAFETY APPLIANCE for RAILWAY TRAINS. Sir W H Dalrymple.
21,313 ECONOMIC MARINE BOILER. J Hall.
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21,328 MECHANICAL STOKERS. W D Grimshaw.
21,339 ELECTRICAL INDICATORS and CONNECTIONS THEREWITH. R H Kettle and C Graham.
21,342 FACILITATING the STARTING of HYDROCARBURETTED AIR ENGINES. W D and S Priestman.
21,348 TREATMENT of ZINC PRODUCED by ELECTROLYSIS. W Wright and J B Hamond.
21,354 APPARATUS for SMOOTHING and SHAPING TUBES. R Mannesmann, jun.
21,357 MULTIPLYING MOTIVE POWER. T Cooper.
21,361 FOOT POWER DRIVING MECHANISM. R Thomson.
21,363 RIVETS. G F Redfern. (*E Pocock*, France.)
21,365 TRANSMITTING MOTION from the WHEELS of MOVING RAILWAY VEHICLES to MACHINERY WITHIN SUCH VEHICLES. M Canio.
21,372 INSULATORS for ELECTRIC TELEGRAPH WIRES. B A J Espeut.
21,374 SCREW PROPELLERS. F W Zimer.
21,376 ELECTRICAL RESISTANCES. H Edmunds.
21,377 ELECTRIC CONDUCTORS. H Edmunds.
21,384 FIRE ALARMS. A Heuer.
21,389 HOT AIR ENGINES. H M L Crouan.
21,392 MACHINES for the MANUFACTURE of MACHINE SCREWS. R J Alpe and H Price.

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21,401 APPARATUS for OPENING and CLOSING RAILWAY CARRIAGE WINDOWS. E F Duvoisin.
21,408 DISC HYDRAULIC VALVE. C Mackenzie.
21,420 ADDING MACHINES.* R Timmis and J F Bell.
21,435 ELECTRIC AUTOMATIC REPEATER CUT-OUT. J and J W Ferrer.
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21,436 MECHANICAL STOKER.* F O Ruppert.
21,448 THRUST BLOCKS for SHAFTS. J A and W C Paul.
21,450 STOP or REGULATING STEAM or OTHER PRESSURE FLUID VALVES. J Peacock.
21,454 APPARATUS for CONTROLLING the FLOW of FLUIDS UNDER PRESSURE. J C Calvert.
21,462 STEAM GENERATORS. J W Restler.
21,464 COMBINED SCALE and SET SQUARE. R Haddan. (*E Duringer*, France.)
21,467 PLATES, BARS, and RODS, HAVING a PARTIAL COATING of OTHER METAL.* L Grambow.
21,475 GAS ENGINES.* L A Enger and Co.
21,478 CONTROLLING POWER-OPERATED STEERING GEAR. W B Basset.

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21,480 APPARATUS for MEASURING ELECTRICITY. G L Anders and W Kottgen.
21,489 BOILER FURNACES for the BETTER CONSUMPTION of FUEL. S Fox.
21,490 HAND-BORING APPARATUS for MINERS USE. F Scott.
21,493 FEED MECHANISM of MACHINES for CUTTING METALS. J F Robinson and G Oldfield.
21,494 AUTOMATIC FIRE-EXTINGUISHING SPRINKLERS. T Witter.
21,499 BOILER TUBES and FURNACES. J MacKenzie.
21,506 ELECTRICAL GOVERNORS for MARINE ENGINES. H A Fergusson.
21,513 COMPOSITION for PREVENTING and REMOVING SCALE from STEAM BOILERS. J Mewse.
21,526 SCREW BOLTS and LOCK NUTS. J and F Maginn.
21,530 AUTOMATIC ELECTRICAL SIGNALLING on LOCOMOTIVE ENGINES. J Atack.
21,532 OIL FEEDERS for SUPPLYING LUBRICANT to STEAM ENGINES. J I Thornycroft.
21,533 APPARATUS for MEASURING ELECTRIC POTENTIALS and QUANTITIES. G C Fricker.
21,534 SPRAY APPARATUS for HYDRO-CARBURETTED AIR ENGINES.* A Altmann.
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21,536 SIGNALLING on RAILWAYS. S Machin and A J Bell.
21,537 DRIVING GEAR for TRANSMITTING POWER. J Bland.
21,549 HYDRAULIC MOTOR. C Eyre.
21,560 RAILWAY SIGNALLING.* R S Wiles.
21,562 VALVE COCKS.* I Cizek.
21,533 FORGING and SHAPING METAL ARTICLES. J J B E Genez.
21,564 MACHINERY for CUTTING and FINISHING CORKS. J Lowman and J S Bucknall.
21,565 FRICTION CLUTCHES. L I Seymour.

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21,578 ARRANGEMENTS for INCREASING the SAFETY of RAILWAY TRAVELLING. C W Sell.
21,579 COMPOUND and MULTIPLE CYLINDER ENGINES WORKING with L or T CONNECTING RODS. H J H King.
21,581 ROLLING TUBES, CYLINDERS, DRUMS, TYRES, RIMS, ETC. P Robinson.
21,583 GIRDERS and OTHER SECTIONED METALS. P Robinson.
21,586 ANTI-FRICTION THRUST BEARING. A J Cairns and others.
21,587 PLURAL-EXPANSION STEAM ENGINES. J Haythorn and J Stuart.
21,588 RELIEF VALVES for STEAM CYLINDERS. W H Bailey.
21,590 COMBINED PNEUMATIC, HYDROSTATIC, and TENSILE TESTING APPARATUS. W H Bailey.
21,602 OPERATING ELECTRIC METERS in such a WAY that CHARGE for the CURRENT can be VARIED. W H Scott.
21,613 TELEPHONIC TRANSMITTERS.* A Groper.
21,621 INCANDESCENT LAMPS.* D V Mito.
21,633 BOILER MUD SKIMMERS or COLLECTORS. H Hayes.
21,645 CHAINS for TRANSMITTING POWER. T J Sloan.
21,654 WATER or OTHER LIQUID GAUGES, for STEAM or OTHER FLUID PRESSURE BOILERS. J Robinson and D Donald.

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SMITHFIELD CLUB SHOW, 1892.

As the Smithfield Club Show, opened on the 5th and closed on the 9th inst., included many exhibits of interest to our readers, we are dealing very fully and promptly with the matter, and for this purpose we shall issue with "The Mechanical World" for Dec. 23rd

A SPECIAL SUPPLEMENT,

in which the various exhibits will be described by practical writers of acknowledged ability.

Although this SPECIAL SHOW NUMBER will entail great additional expense, the price of the Journal will still be One Penny.

Those exhibitors who have not yet arranged with us for notices are invited to do so without delay, in order that full justice may be done to their specialities by our editorial representatives.

We would point out that as the ORDINARY circulation of "The Mechanical World" now exceeds 20,000 copies weekly the value to exhibitors of descriptive notices in this special issue cannot be overrated.

FRIDAY, DECEMBER 16TH, 1892.

The Epstein Secondary Battery.

A FEW months ago we mentioned that a trial of the Epstein accumulator was to be made on some of the self-contained cars now running in Birmingham. Being a new battery we have waited with somewhat more than usual interest to hear what results were obtained with the cells. We are now informed by Mr. Epstein that the batteries which have been in operation on the above-mentioned line have given entire satisfaction, and that as a further proof of this a repeat order has been given for another six sets. The experience gained with these cells has proved to the Epstein Electric Accumulator Company that the maintenance of the batteries at the rate of 1½d. per car mile is as satisfactory to the tramway company as it is to the contractors. From this we conclude that the latter have undertaken to maintain the batteries at that figure, a matter of which we were not aware. It seems, however, rather early, after only four months' operations, to draw a definite conclusion on the subject. This is, however, only by the way. Nevertheless—and this seems to confirm the statement that the rate of 1½d. per car mile is correct—we understand that the company are prepared to enter into similar contracts with other tramway companies, and that they shortly expect to have several lines worked by means of their cells. We trust that this will be the case. It is far better to assume 1½d. per car mile than 1d., the latter figure having hitherto proved entirely delusive. We shall look forward to the time when Mr. Epstein will be in a position to publish full details concerning the behaviour of the cells, in practical work on the Birmingham line. Of course, we do not anticipate that this will be the case before the expiration of another year; but in the meantime, the forthcoming equipment of other lines with the Epstein accumulator is very significant, and if the Epstein accumulator proves to be *the* secondary battery cell for traction purposes, we shall be happy to record the fact.

Water Power in Switzerland.

WATER POWER is already largely used in Switzerland, and a further extension in this direction is proposed by the Neuchatel municipality by the utilisation of the Reuse. Plans for the carrying out of the work are now being asked for, and prizes will be awarded to the three most suitable. It is intended to tap the stream at Pré aux Clées, where the maximum water power available is estimated at 2800H.P., and the minimum at about 1000H.P. The fall of water amounts to 170ft., and the volume averages 3000 litres per second. The actual carrying out of the works is neglected in the present instance, and the plans asked for call for the supply of the turbines, dynamos, conductors, and all necessary apparatus. The electrical energy will be used for electric lighting and transmission of power in Neuchatel-Serrière, about five and-a-half miles from the generating station; and a similar application in the intervening and neighbouring localities, and for traction purposes. The system to be employed must be definitely stated, and competitors are left to choose that particular one which they may consider most suitable. Particulars must be given concerning the pressure proposed to be used, speed for the cars, method of conversion, and estimated working expenses. A committee of technical experts has been appointed to decide the competition. The three prizes will be £120, £160, and £200 respectively, and they will be awarded to the senders of the three best schemes. The plans, which must reach their destination not later than the 15th January next, are to be sent to the Direction pour les Travaux publics de la Commune de Neuchatel, from whom further particulars or a detailed programme may be obtained on application.

Electric Power in Lyons.

SOME time ago we referred to a scheme for the utilisation of the river Rhone for the supply of electric light and power in Lyons. Since then the project has assumed a much larger and more definite shape. It is now intended to construct a canal tapping the waters of the Rhone about 17 miles above Lyons, and bringing them down to Villeurbanne le Cusset, a place just outside the city. Here will be erected a number of turbines which will operate dynamos, and the current will be transmitted to six sub-stations in Lyons. The normal output of the station will be about 8000H.P., and the reserve will bring this up to 10,000H.P. The undertaking is to benefit the small industrial enterprises, and especially that of the silk weaver, which, owing to the competition of large factories, is threatened with destruction. It is proposed to supply current also for lighting and traction purposes. If the scheme is carried out—and it is said that a capital of one million pounds has already been subscribed to accomplish this object—the installation will be the largest of its kind on the European continent.

"Arcas" Silver-plating.

REFERENCE has been previously made in this journal to the "Arcas" silver-plating process introduced by the London Metallurgical Company, and on Friday last the directors gave a further demonstration of the capabilities of the system, especially as regards an alloy of cadmium and silver. It was explained that this alloy can be deposited in any desired proportion—that is to say, any predetermined percentage of either can be deposited. The articles coated have the appearance of ordinary silver plate, and it is claimed that in the long run a saving of over 25 per cent. is obtained. Certain secret chemicals are used in the depositing bath, and these, combined with the keeping quiet of the amount and pressure of the current passed through the bath, are the points which, it is said, have caused the system to be a success. A new company has been formed to take over the business, and subscriptions for shares will shortly be invited.

The Latest Automatic Machine.

OF automatic machines depending for their working upon mechanical means there are many, but probably the first machine of this class operated by electricity has just been constructed by a Berlin firm. A coin is placed through a slot in the usual manner, and the act of doing so completes an electric circuit. This attracts the armature of an electro-magnet, and the movement of the former automatically causes the article purchased to be pushed out in front of the buyer without the necessity of the latter pulling out a drawer or box, as is the case with other automatic machines. This new machine is considered suitable for the sale of railway tickets on local lines, and for theatre and tramcar tickets, etc.—in Germany.

Dr. Werner Siemens.

WE much regret to record the death of the well-known electrical engineer, Dr. Werner Siemens, which occurred on the 6th instant. Dr. Siemens, who was born at Lenthe, near Hanover, in 1816, entered the Prussian Artillery as a volunteer in 1834, and from 1841 to 1849, when he retired from the army, he displayed a ceaseless activity in inventing and perfecting, under the auspices of the Prussian Government, various processes of galvanising gold and plating silver. He also devoted himself to constructing and developing the systems of electric telegraphy, the most important of the latter being the first great telegraph line on the Continent—that between Berlin and Frankfort,—which he established under the authority of the Prussian Government in 1849. Six of the existing Atlantic cables, as well as many other submarine systems, were laid by Messrs. Siemens Brothers Limited, to the formation of which company Dr. Siemens greatly contributed. Dr. Siemens was the inventor of the pneumatic tube system and several important improvements in dynamos for electric lighting, and was an honorary member of the British Association and of most of the European electrical and scientific societies. In 1886 Dr. Siemens presented 500,000 marks to the German nation for the foundation of a national scientific and technical institution. In 1888 he was ennobled, and in the same year he published a collection of scientific treatises. The degree of Ph.D. was conferred on him by Berlin University in 1874.

Hot Water on Draught.

A SHORT time ago the municipality of Paris granted a concession to a company to erect in various quarters of that city a series of automatic machines—very much resembling the newspaper kiosks—for the supply of hot water to the public. These machines, which have been devised by M. Robin, supply about two gallons of water at a temperature of from 60° to 80° for a halfpenny. To obtain the water it is only necessary to put a coin of that amount through a slot and place the receptacle for the water underneath the outlet pipe. It might perhaps be supposed that the water is heated in advance; but this is not the case: it is only heated when required. The act of inserting the coin causes a certain quantity of water to pass from a reservoir through a coil of piping which is heated by a series of gas jets, thus warming the water, which then flows down to the outlet pipe to the can or pail of the purchaser. This series of gas jets does not burn continuously, but only when the hot water is required, and the jets when wanted are lighted automatically by means of a small jet always alight. These machines have, as a commencement, been erected in the vicinity of cab ranks, so that the drivers may replenish their hot-water heaters when necessary. We must not omit to mention that the supply of water to the reservoir passes into it through a meter from the town mains.

Leeds Association of Engineers.

AT the last monthly meeting, held in the lecture room, the president (Mr. Robert Lupton) in the chair, Mr. Geo. W. Blackburn (hon. secretary) presented the report and balance sheet for the year ending October 31. It showed a considerable improvement in the financial position of the association, and a further increase in membership.

Mr. W. Norris, M.I.M.E., of Lincoln, read his second paper on "The Theory of the Modern Gas Engine." He dealt with the four-cycle gas engine, and compared it with the best type of modern compound condensing steam engine, contending that the former was decidedly the more efficient. He stated that Lord Armstrong said some 11 years ago that if the entire heat energy of a good condensing steam engine be divided into ten equal parts, roughly speaking, two parts escape by the chimney, one is lost by radiation and friction, six remain unused when the steam is discharged, and one only is realised in useful work. In other words, 90 per cent. of the heat energy of the fuel is lost. Speaking of the losses in the gas engine, Mr. Norris said the loss of heat to the jacket water depended on the difference of temperature between the gases in the cylinder and the water in the jacket, the extent of surface exposed to the heated gases and the cooling water, the time the gases are allowed to be in contact with the walls of the cylinder, and the thickness of the metal forming the body of the cylinder. In some engines there is a saving of from 7 to 10 per cent. due to the diminished loss of heat by using jacket water at 158° F. against 64° F. It must not, however, be supposed that increase of temperature of jacket water will always conduce to economy. He showed that increase in velocity of expansion, causing more rapidity in combustion, gave rise to great pressure and diminished loss of heat through cylinder walls. The loss in discharging

the gases at high temperatures could only be reduced by increasing the range of expansion, and so reducing the temperature of the gases. Compression reduces the losses and increases the efficiency in gas engines by allowing the expansion of the gases to be carried to a much greater degree, and reducing the surface in contact with the heated gases. If the mixture of air and gas contains more than 66 per cent. or less than 25 per cent. of gas, it will not explode. In the former case it will not ignite, and in the latter it burns quietly away. Speaking of the results obtained from a 16 effective H.P. Robey gas engine, the average pressure is 75lb. per square nch; terminal pressure, 24lb.; efficiency 83; heat turned into work, 21 per cent.; rejected in jacket water, 44 per cent.; rejected in exhaust, 35; working with gas having a calorific value of 601 B.T.U. The actual heat supplied to this engine amounts to 12,000 thermal units per I.H.P. per hour, which corresponds to 21 per cent. of absolute efficiency. The efficiency of a perfect engine working between the same temperatures as those calculated for this engine would be 81 per cent. He next spoke of the automatic tube ignition, which had been known some 30 years, although only turned to practical use about 10 years ago. After some years of careful experimenting he had come to the conclusion that there is no known method of igniting a compressed charge of gas and air which admits of obtaining the same results as by simply forcing a charge of gas and air into a tube always open to the cylinder.

Speaking of large power gas engines, the lecturer showed photographs and drawings of an 86 effective H.P. Robey gas engine which, employed in conjunction with a gas plant, will work on a consumption of 1¼lb. of anthracite coal per E.H.P. per hour. Starting gear was used on these large engines known as Richardson and Norris double-acting pressure starters. A reservoir is charged with compressed air by a small compound pump to 95lb. per square inch, and when the crank is on the instroke compressed air is allowed to rush in until the piston has travelled ⅛ of its outward stroke, and then automatically cut off. Two impulses are sufficient to start with a load on.

Speaking of the gas engine of the future, he thought it would have a gradual combustion, or be what is better known as the flame engine. By the aid of a blackboard he showed what actually took place in an engine of this type; the various points of cut-off, the comparative low maximum effective pressure, and the very high average pressure being clearly described.

A discussion followed, in which Mr. R. H. Wood remarked the difference which existed in the use and application of the water jacket in the case of the steam engine and in the gas engine. In the case of the latter it was as essential to it as it was to the Maxim gun.—Mr. Drake referred to the difficulty of getting gas of such a uniform richness as to explode at the precise moment at which the piston was at the bottom of its stroke, and was not sure that the timing valve was not the best.—Mr. Towler thought that the steam engine could hold its own against even so formidable a rival as the gas engine, especially in the case of high powers.—Mr. Blackburn spoke of the value of a quick expansion in preventing loss of heat through the jacket. — Messrs. Lupton, Atkinson, and Tempest, also spoke, after which Mr. Norris replied to the criticisms of the various speakers, and a vote of thanks to this gentleman, proposed by Mr. Towler and seconded by Mr. Blackburn, was carried with enthusiasm.

The Birmingham Association of Mechanical Engineers.

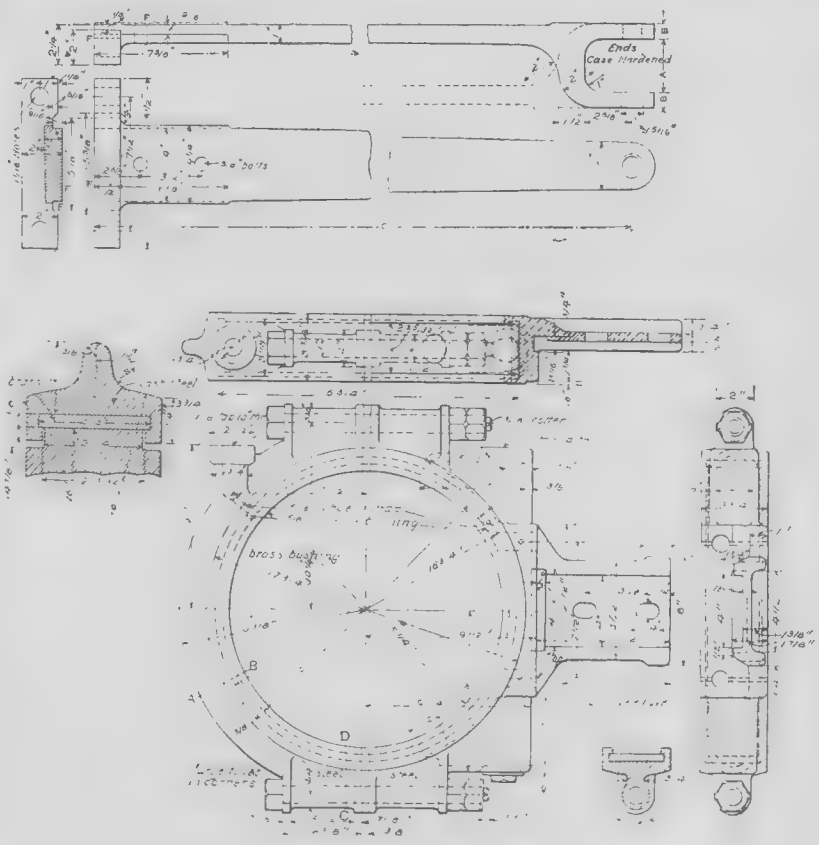
THE annual meeting of the above association was held on Saturday, the 3rd inst., at the Midland Institute, Birmingham, Mr. A. Driver, president, in the chair. After the ordinary business had been transacted, the election of officers was proceeded with. The retiring president; vice-president, Mr. J. Floyd; treasurer, Mr. J. F. Crockatt; and the following four members of the committee—viz, Messrs. H. Winwood, F. Boham, J. Mills, and J. C. Bayliss,—were unanimously re-elected for the ensuing twelve months. Mr. E. Barnes was elected auditor *ex* Mr. F. Page, and Mr. L. O'Brien was re-elected secretary. The proposed change of meeting place was next under consideration, and it was ultimately decided that the future meetings of the association be held at the Grand Hotel, Colmore row, Birmingham.

IT is stated that coal has been discovered about 26 miles from the town of Meshed, Persia.

A Steel Eccentric Strap and Combination Rod.

As an example of recent American locomotive practice we give an illustration from the "Railroad Gazette" of an eccentric strap, introduced experimentally on the Baltimore and Ohio Railroad by Mr. George B. Hazlehurst, superintendent of motive power, about three years ago, and which has given very satisfactory results. About twenty engines were fitted with this form of strap, and they have been in all kinds of service, and on various divisions of the road. The first broken strap was recently reported after running 172,000 miles.

The strap is made of cast steel, and is lined with a brass bushing ⅜in. thick, which is set into a recess turned in the strap, as shown in the sectional views. On account of the superior strength of steel castings these straps can, of course, be made considerably lighter than cast-iron straps. A further possible advantage is gained from the fact that the coefficients of expansion of cast steel and brass are considerably larger than that of cast iron, and therefore in case of heating the steel strap expands more than the cast-iron sheave, giving additional freedom. The difference in the expansion of a 16in. sheave and strap, with the range of temperature which is likely to occur in practice, is, however, not sufficient to make this a very important feature, although the effects of any elevation of temperature are undoubtedly in the right direction.



ECCENTRIC STRAP AND ROD.

In connection with this strap a form of eccentric rod having a combination foot has been used, which we also illustrate. It will be seen that this rod is formed with a T end, and is bolted to the strap as usual with rods of this form, but that it is also bolted transversely to the strap with two through bolts. The holes in the projection of the strap for the latter bolts are oval, thus providing for adjusting the length of the rod, liners being used at the end of the rod, while the four bolts make a very rigid connection.

Practical Electrical Units.—VI.

SPECIAL UNITS.

IN the paper on electromotive force, particular attention was drawn to the fact that electricity in motion is produced by the conversion of one kind of energy (mechanical or chemical, say) into that of another. For nearly all practical purposes mechanical energy is the kind made use of, and as we are accustomed to measure mechanical power in certain units, it will be convenient to explain the units used to denote electrical power by referring to the units used to denote mechanical power.

We have already pointed out that energy is the capability of doing work, and that energy is measured by the number of units of work done. In mechanics, work is said to be done by a force acting through a certain distance in the direction of the force. Water, for instance, falling from a height can do work; and it is obvious that if 100lb. of water falling through a distance of 1ft. does a certain amount of work, the same amount of water falling 2ft. does twice that amount of work. Perhaps the converse of this will be more apparent. To lift 100lb. of water vertically against the force of gravity through a distance of 1ft. requires the expenditure of a certain amount of energy—that is, a certain amount of work is done, and in lifting 100lb. of water vertically against gravity through a distance of 2ft., twice the amount of work is done. It will be noticed that work is made up of two components—force and distance, or, more correctly, force and motion,—and among engineers the unit of work is the *foot-pound*—that is, the work done by a force equivalent to the weight of 1lb. acting through 1ft., or the work done in lifting 1lb. vertically against gravity through a distance of 1ft. If 2lb. are lifted through 1ft., two units of work are done; whilst if 2lb. are lifted through 2ft., four units of work are done. Work, then, is measured by the product of the force and the distance.

So far the time taken has not entered into the consideration of the work done. It is evident, however, if it takes longer for one person to lift 2lb. through 2ft. than another person to do the same, that the power in each case exerted is not the same. Work, then, is not the same as power. Power is the rate of working, being defined as the work done in unit time. The unit of power adopted by engineers is called a horse-power (H.P.), which is the power of doing 33,000 foot-pounds of work per minute. The H.P., then, of a machine is the number of foot-pounds of work done per minute divided by 33,000, indicating the rate at which an engine or machine can do work.

The principle of work is applicable to electrical energy, and to show the connection between the above unit or rate of working and the unit of electrical power, we shall refer to the dynamo as the best means of converting mechanical energy into electrical energy. As it is well known that a certain amount of mechanical energy expended in driving a dynamo will produce a certain ampèrage and E.M.F., current strength and electrical pressure (E.M.F.) are the components which make up the electrical energy given in exchange, as it were, by the dynamo for the mechanical energy supplied. It is not the place here to prove that a dynamo may be designed to give a high E.M.F. and low ampèrage, or a low E.M.F. and high ampèrage, and it will be sufficient to state that the same mechanical power expended in driving the dynamo will produce 20 ampères with a pressure of 50 volts, or 100 ampères with a pressure of 10 volts. And in a similar way to that in which we have shown that the product of the number of pounds and the number of feet moved through per minute, or the number of foot-pounds per minute, measures the mechanical power expended, we can show that the product of the number of volts and the number of ampères measures the electrical power generated, developed, or absorbed in any part of a circuit. This product may be termed so many volt-ampères, but it is usual and more convenient to term them so many watts, which is the unit of electrical power; hence E (volts) × C (ampères) = W (watts).

The watt is one of the units most commonly met with in practice, and may be defined as "the power developed in a circuit when one ampère flows through it under a pressure of one volt." It will be well to point out here that the number of watts equals the amount of work done in a certain time, since the number of ampères denotes the amount of current flowing per second (see Paper I.), so that the actual work done depends upon the time, and is measured by the product C (ampères) × E (volts) × t (seconds). If a dynamo were driven by a 1H.P. engine, and no energy lost in heat, friction, leakage, etc., then we should receive back 1H.P. of electrical energy, which, upon multiplying the voltage by the ampèrage given out by the machine, would be found to be 746 watts. Therefore 746 watts = 1H.P. = 33,000 foot-pounds per minute. A few examples will now be considered.

Example 1.—A current of 15 ampères is sent through a circuit of 4 ohms resistance. What power in watts is absorbed?

By Ohm's law E = C × R = 15 ampères × 4 ohms = 60 volts, and since power absorbed = C (ampères) × E (volts), the number of watts = 15 ampères × 60 volts = 900 watts.

Example 2.—What horse-power is absorbed in lighting 500 110-volt lamps, arranged in parallel, when the resistance of each is 220 ohms?

The resistance of the 500 lamps, arranged in parallel, $= \frac{220}{500} = \frac{22}{50}$ ohms, and since by Ohm's law $C = \frac{E}{R}$, therefore C = 110 (volts) $\div \frac{22}{50}$ ohms $= 110 \times \frac{50}{22} = 250$ ampères. Then power absorbed = C × E = 250 (ampères) × 110 (volts) = 27,500 watts $= \frac{27,500}{746} = 37$H.P. nearly.

Example 3.—What horse-power is absorbed in lighting the above lamps joined in series?

By Ohm's law each lamp requires $\frac{110 \text{ (volts)}}{220 \text{ (ohms)}}$ or ½ ampère. Therefore 500 lamps require 500 × ½ or 250 ampères, and power absorbed = 110 (volts) × 250 (ampères) = 27,500 watts = 27,500 ÷ 746, or nearly 37H.P.

Example 4.—Three incandescent lamps of 55, 50, and 45 ohms resistance respectively are arranged in series. What horse-power will be absorbed if 2½ ampères is sent through them, neglecting the resistance of the leads.

Total resistance = 55 + 50 + 45 = 150 ohms, and since by Ohm's law E = C × R, the voltage required to send 2½ ampères is 2½ (ampères) × 150 (ohms) = 375 volts.

Therefore, horse-power absorbed

$$= \frac{2\frac{1}{2} \text{ (ampères)} \times 375 \text{ (volts)}}{746} = \frac{937{\cdot}5}{746} = 1{\cdot}25\text{H.P.}$$

Example 5.—A 100-volt dynamo of 1 ohm resistance is used for lighting an arc of 3 ohms resistance. If the resistance of the leads is 1 ohm, find the number of watts absorbed, and the number of watts absorbed by the dynamo, lamp, and leads separately.

By Ohm's law the current in the circuit $= \frac{100 \text{ (volts)}}{(1 + 3 + 1) \text{ ohms}} = 20$ ampères; and E.M.F. of lamp = C × R = 20 (ampères) × 3 (ohms) = 60 volts; E.M.F. of dynamo = C × R = 20 (ampères) × 1 (ohm) = 20 volts; E.M.F. of leads = 20 (ampères) × 1 (ohm) = 20 volts. Therefore watts absorbed in circuit = 20 (ampères) × 100 (volts) = 2000 watts; watts absorbed in dynamo = 20 (ampères) × 20 (volts) = 400 watts; watts absorbed in leads = 20 (ampères) × 20 (volts) = 400 watts.

It will be noticed that the E.M.F. distributes itself in the circuit according to the resistance of the separate parts (see Paper V.).

Another unit of power, adopted as the commercial unit of power, is the kilowatt, equal to 1000 watts. Since the watt = $\frac{1}{746}$ of 1H.P., it will be noticed that the value of the watt is extremely small, and, consequently, that large and somewhat inconvenient numbers have to be used to denote the power and size of large dynamos in watts. For instance, a dynamo supplying 500 ampères at a pressure of 120 volts gives out

energy at the rate of (500 × 120) watts, or 60,000 watts. Expressed in horse-power this would be $\frac{60,000}{746}$ or 80·4 H.P. It is certainly more convenient to denote its power as 60 kilowatts, or its size as a 60-unit machine. A little consideration will show how the number of kilowatts can be easily turned into its equivalent horse-power. One thousand is slightly more than 1⅓ times 746, therefore 1 kilowatt corresponds approximately to 1⅓ H.P., and the H.P. of a dynamo is obtained by adding ⅓ of the number of commercial units of power (kilowatts) to that number of units (kilowatts). Thus in the above case the H.P. of the 60-kilowatt machine is 60 + ⅓ of 60 = 60 + 20 = 80 H.P.

Now that we are able to express in proper units the equivalent electrical energy of a certain amount of mechanical energy, we are in a position to consider the question of converting electrical energy into heat and light. In a glow lamp, for instance, a certain voltage and ampèrage is required to produce a certain amount of light; in other words, glow lamps consume a certain number of watts of energy, and the heat produced per second is proportional to the number of watts consumed. And as a body becomes luminous and emits light when its temperature is very high, it follows that the light produced is proportional to the energy absorbed, so that all glow lamps giving the same light approximately absorb the same power. The practical unit of light is the "candle-power" (C.P.), which is the amount of light produced by a standard candle weighing 6 to the lb., and burning 120 grains of spermaceti wax per hour. In practice it is found that 1 H.P. of electrical energy is required to produce an amount of light equal to 200 C.P., so that we may accept the statement claimed by the Edison-Swan Company that each candle-power produced absorbs 3·5 watts; therefore an ordinary 16 C.P. lamp requires 16 × 3·5 = 56 watts. We have already seen that these 56 watts may be sub-divided into volts and ampères as desired, so long as the product of the two is 56; and as the resistance of different lamps may vary, it follows that the number of ampères required to produce a desired light equal to a certain number of candle-power will vary with different lamps, consequently the required voltage will vary with different lamps. For this reason it is usual and convenient to mark the voltage required to send the necessary current through the lamps, and to designate the lamps, 60, 100, and 110-volt lamps, as the case may be. Thus a 60-volt 16 C.P. lamp is one giving light to the extent of 16 C.P., and requiring 60-volts to send the requisite ampèrage through the lamp. From these data and the fact that a 16 C.P. lamp absorbs 56 watts, the necessary amount of current is easily determined as follows:—Since volts × ampères = watts, therefore ampères $\frac{\text{watts}}{\text{volts}}$, and the number of ampères in the above case is $\frac{56}{60}$ or 0·93 ampère, or nearly 1 ampère.

Example. — What number of candle-power corresponds to 1 H.P., if one 32 C.P. lamp absorbs 108 watts?

Since 108 watts correspond to 32 C.P., and 1 watt corresponds to $\frac{32}{108}$ C.P., therefore 1 H.P., or 746 watts, corresponds to $\frac{746 \times 32}{108} = 221$ C.P.

If we know the voltage and ampèrage required by a certain lamp, the necessary horse-power to light a given number of lamps is found by dividing the product of the number of lamps, voltage, and ampèrage by 746, or H.P. = C (ampères) × E (volts) × N (No. of lamps) ÷ 746.

Another unit—the English unit of electrical energy (viz., the legal quantity fixed by the Board of Trade for the purpose of public supply)—must now be considered. Suppose a 100-volt lamp requires 1 ampère of current, then 10 such lamps would absorb 1000 watts, or 1 kilowatt, and if a circuit supplied energy at this rate for 1 hour, 1 Board of Trade unit (B.T.U.) of electricity would be supplied. The B.T.U. (commercial) of supply is 1000 watt hours or 1 kilowatt hour.

Example.—How many B.T.U.'s would be required to light 5 50-volt 16 C.P. lamps for 4 hours, supposing each lamp takes 1 ampère to light it?

Each lamp absorbs 50 × 1, or 50 watts; therefore 5 lamps absorb 5 × 50, or 250 watts, or $\frac{250}{1000}$, or ¼ of a B.T.U. per hour; therefore in 4 hours 4 × ¼ unit would be required.

(*Concluded.*)

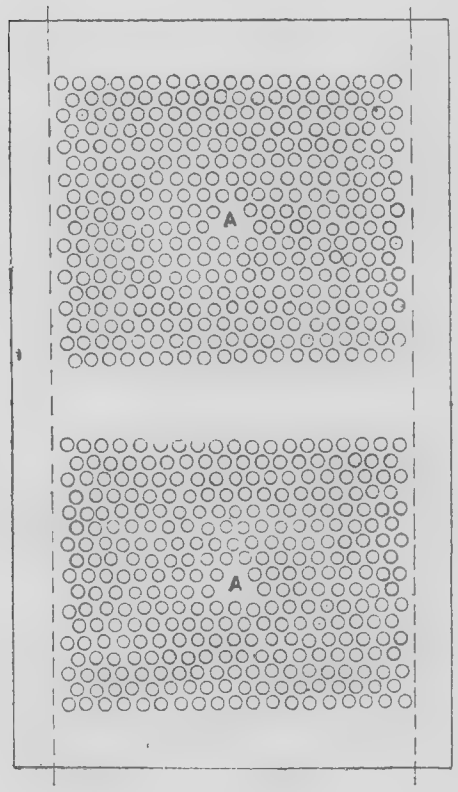


FIG. 1

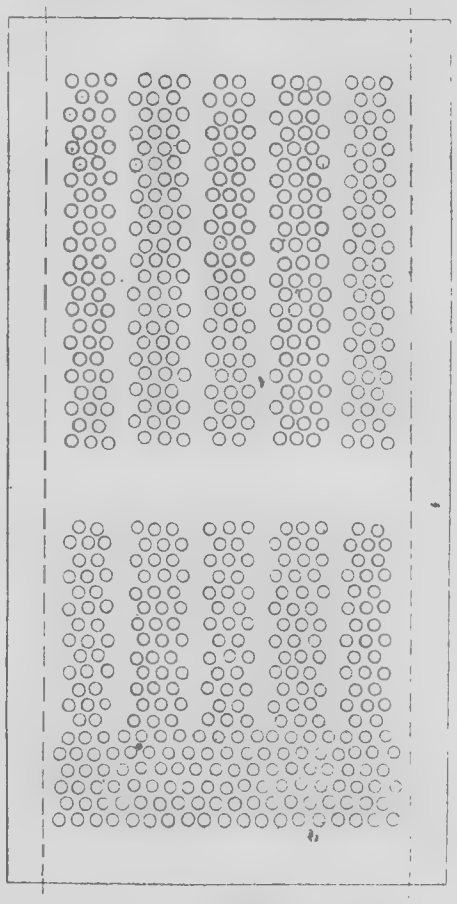


FIG. 2.

The Arrangement of Condenser Tubes.

IN pursuing the subject of economy in steam engines, it is impossible to overrate the importance of minute details; and the consideration of the effect of various modes of construction of individual parts on the efficiency of an engine forms an almost inexhaustible field of inquiry for the engineer who is bent upon realising the utmost possible economy. We have previously referred to some of the details of construction, both in the engines and boilers manufactured at the Central Engine Works, West Hartlepool, which have been conducive to their high reputation, and we are now enabled to describe another detail, which, though at first sight apparently insignificant, is, on full consideration, a matter of great importance. We refer to the arrangement of the tubes in a condenser. The ordinary method universally adopted elsewhere is to place the tubes as close together as possible in one, two, or more large nests, without any break or wide openings whatever. The steam to be condensed is expected to find its way as rapidly as it is entering the condenser to the cooling surface on which it is to be condensed. If, however, we look at an ordinary tube plate, such as that shown in Fig. 1, and consider how the steam is to get to a tube placed centrally, say at A, the absurdity of the ordinary method of arranging the tubes will at once be apparent. There is a distance between the tubes of perhaps $\frac{5}{16}$ or $\frac{3}{8}$in., and the steam must wriggle its way from the outside of the nest through these narrow interstices to the surface on which it is to be condensed; and let it not be forgotten that it must not be condensed until it arrives at the proper tube, otherwise each tube will not be doing its fair share of the work. To put the matter another way, it appears to require very little consideration to show that unless the tubes are very much more widely spaced apart than they are in universal practice, a large number of tubes at the centre of the nests might be taken out without any loss of vacuum; or, if tubes were drawn in such a way as to make wide gaps to enable the steam to enter quickly to the very heart of the cooling surface, a better vacuum would in all probability be obtained. This system is shown in Fig. 2, where it will be seen there are five or six wide gaps running from the top to nearly the bottom of the nests of tubes, into which the steam can rush very rapidly, and from which it only has to pass one tube in making its way to the inner-most tube upon which it is to be condensed. This is like making wide main streets into the heart of a town, the narrow streets only forming passages from one wide thoroughfare to another. There is, however, another fault in the ordinary arrangement of a condenser, and that is, that whilst the steam may be admitted on one side of the centre of the length, it is common practice to fit a solid tube plate, or supporting plate, in the middle of the length of tubes, which practically forms a blank flange, excepting at the top above the tubes, and thus fairly effectively cuts off one-half of the condenser from the inrush of the steam. The arrangement of the tubes with the wide gutter-ways between, as shown in Fig. 2, has opened up a way to get over this second difficulty, and Mr. Mudd now arranges his supporting plate rather as a series of long narrow plates than as one complete plate. These narrow plates take the three vertical rows of tubes only to each plate, and are set 4in. or 5in. before or behind each other in zigzag order across the condenser, so that they constitute nothing approaching a blank flange, the steam being able to rush rapidly from end to end of the condenser amongst the tubes. These details of condenser construction are certainly highly interesting, and it is curious to note that Mr. Mudd's first experiment consisted in drawing out 26 tubes from the condenser of an old steamer, which condenser thereupon gave an inch better vacuum than formerly.

The Ellipse and Elliptical Gear Wheels.

[CONTRIBUTED.]

THE ellipse is one of the simplest and most common of the curves which have been investigated by mathematicians, and a knowledge of its properties and shape are of great value to all who have to do with mechanical work, from the manager to the youngest apprentice.

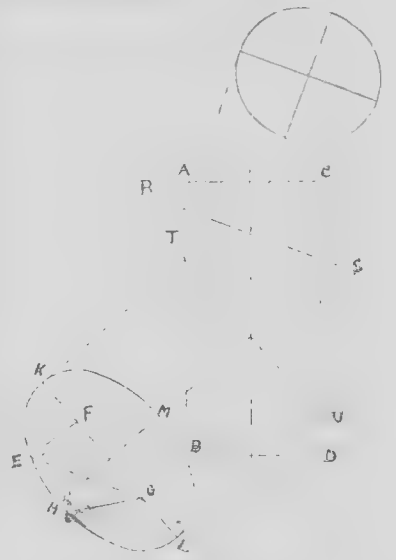


FIG. 1.

Anyone who cuts off and files up a bolt or round bar "on the skew" leaves an ellipse as the resulting surface. A "butterfly" throttle valve and a damper in a round chimney are both of the shape of an ellipse.

"An ellipse is the curve formed by an oblique section of either a cone or a cylinder passing through its curved surface without cutting the base." Fig. 1 shows a cylinder A B C D, cut at different angles of obliquity by two planes, R S and T U. The projections of the section surfaces are shown above and below respectively, and both of these are ellipses. It will be seen that if A B C D represents a circular pipe, then these projections give the shape of a thin plate throttle valve for the same.

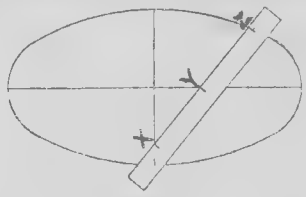


FIG. 2.

One of the important properties of the ellipse is, that the sum of the two distances F E, E G from two points F and G to any point E on the ellipse is a constant quantity. These two points are called the "foci" of the ellipse. This property leads at once to a practical method of drawing an ellipse, which is as follows:—

At two points, F and G, drive two wire nails or place two pins. Take a piece of thread and make a loop at each end of it, putting the loops over the nails or pins and leaving a slack piece of thread between. Put the point of the pencil E into this slack piece, and keeping both arms of the string tight run the pencil round and it will trace out the ellipse. The total length

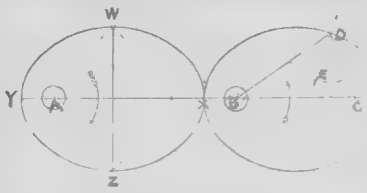


FIG. 3.

of the string between loops—*i.e.*, the sum of the lengths F E, E G, or F H, H G—is the whole length K L of the "major axis" of the ellipse.

In marking out an ellipse, the conditions generally given are the lengths K L and H M of the major and minor axes—as when an "oval" table is to be marked out on a piece of wood of certain breadth and length. In that case the foci are first ascertained by taking half the length of K L in the compasses and striking arcs therewith from centre M or H, cutting

the major axis in F and G the required foci. The above method is rapid and handy, but is subject to the drawback that the two parts of the thread may stretch unequally, or the thread may chafe and become irregular.

A more accurate practical method is as in Fig. 2. A strip of paper, wood or tin plate is cut and a line scribed at Z. Z X is now made equal to half the major axis, and Z Y equal to half the minor axis. Now wherever the strip is laid, if X is upon the minor axis and Y upon the major axis, the point Z will always be a point on the periphery of the ellipse.

By marking a succession of points in this way, and drawing a curve through them with a French curve, a very accurate ellipse can be struck.

This method is very useful in the drawing-office, as wherever any cylindrical part is inclined, either in plan or elevation, its end will present an ellipse to view, as in the case of the plan of a pair of oscillating or inclined engines. A few points being found on the ellipse in this way in pencil, the ink compasses are set so as to draw four circular arcs very nearly coinciding with the true ellipse.

A very useful application of the ellipse is for the "eccentric wheels" used to give a "quick-return" motion in slotting and other machines. The properties of the curve are such that two equal ellipses revolving on alternate foci will roll on each other—*i.e.*, that at every point of the revolution the peripheries are in contact on the straight line joining the centres of revolution. The periphery being made the pitch line of the wheels, the two will gear together as in Fig. 3, where A and B are the foci and centres of shafts on which the wheels revolve. The velocity ratio of the wheels in the position shown is the maximum, and B being the driving shaft is equal to $\frac{XB}{AX}$. Suppose XB is made 6in. and XA 18in., then in the position shown A will revolve ⅓ as fast as B. When both wheels have revolved through 180° or turned half a revolution, the velocity ratio will be exactly reversed, and A will revolve three times as fast as B. Therefore the maximum variation in angular velocity will be from a speed of 1 to a speed of 6.

In designing a pair of "eccentric wheels" this variation in angular velocity is the first thing to determine. Suppose the maximum differences of angular velocities of the two shafts is to be 4, then AX must be twice XB.

The actual sizes of the wheels will be determined by making X B the minimum possible to allow room for the shaft, the boss on the wheel casting, and the rim and teeth. Suppose X B—*i.e.*, from centre of shaft to pitch line—is 8in., then X A must be 8in. × 2 = 16in. The major axis X Y of each wheel will then be A X + X B = 16in. + 8in. = 2ft. The minor axis will be found by taking half the length of X Y in the compasses, and striking arcs from the foci, cutting the bisecting perpendicular W Z in Z and W. The pitch lines for the wheels can then be set out by the above methods. The teeth can now be marked out on this pitch line as for an ordinary sour wheel, but the centre lines of the teeth must be specially found. In a circular wheel these radiate to the centre; in an elliptical wheel each must be specially set out. To D, the centre of each tooth as stepped out on the pitch line, draw from the foci B D and C D. Biscet the angle B D C by E D; then E D is the centre line on which to mark off the tooth.

The Value of the Steam Jacket.

(*Continued from page* 238.)

Jacket Water and Drain Water.—The discharge from each jacket and from the receiver drain was made to deliver into a separate bucket, and the weight of water in each bucket was determined. During the trial with steam in the two cylinder jackets, 2351b. of jacket water was obtained from the jacket of the high-pressure cylinder, and 4811b. from the jacket of the low-pressure cylinder. This gives a total of 7161b. of jacket water from both jackets in 5·57 hours, or 128·6lb. per hour, which is equivalent to 5·67 per cent. of the total feed water.

The drain water obtained from the receiver drain was 701b. in 5·97 hours, or 11·7lb. per hour, during the trial without steam in any of the jackets; and 1101b. in 5·57 hours, or 19·8lb. per hour, during the trial with steam in the two cylinder jackets.

Measurement of Pressures, etc.—Readings were taken every quarter of an hour of the steam pressure in the boiler and of the vacuum in the condenser. Each of these gauges was therefore read 25 times during the trial without steam in any of the jackets, and 23 times during the trial with steam in the two cylinder jackets. The pressure gauges on the two steam jackets were also read every quarter of an hour throughout the trial. Indicator diagrams were taken from each end of each cylinder every quarter of an hour by means of four Richards indicators. In this way, 25 sets of diagrams, or 100 single diagrams in all, were obtained during the trial without steam in any of the jackets, and 23 sets of diagrams, or 92 diagrams in all, during the trial with steam in the two cylinder jackets. The engine counter was also read every quarter of an hour throughout both of the trials. The following table gives the average mean effective pressure and indicated horse-power in each of the two cylinders throughout both of the trials :—

—	Mean Effective Pressure. Lb. per sq. in.		Indicated Horse-power.	
Date of Trial 1890 Jackets, with or without steam	Mar 15 Without.	May 17 With.	Mar 15 Without.	May 17 With.
	lb.	lb.	I.H.P.	I.H.P.
H.P. cylinder..	18·95	15·12	64·2	57·1
L.P. " ..	4·21	4·60	46·3	56·3
Total.....	10·05 (reduced to L.P. cylinder.)	9·26	110·5	113·4

Temperatures.—During the trial without steam in any of the jackets, the temperature of the feed water was observed nine times, of the hot well 23 times, and of the circulating and discharge water each 29 times. During the trial with steam in the two cylinder jackets, the temperature of the feed water was observed 13 times, of the hot well 20 times, and of the circulating and discharge water each 33 times. The following table shows the mean temperatures obtained by calculation from these readings :—

Date of Trial 1890 Cylinder Jackets, with or without steam	March 15 Without.	May 17 With.
Temperature of feed water .....F.	57·8°	82·7°
Temperature of hot well .....F.	67 8°	79·3°
Temperature of circulating water ...F.	43·7°	58 8°
Temperature of discharge .....F.	53·6°	85·3°

Boiler.—Steam was supplied by a Lancashire boiler made by Messrs. Clayton. The boiler is 6ft. 6in. diameter and 32ft. long, and the flues are 2ft. 6in. diameter. The grate area is 35sq. ft. and the total heating surface is about 880sq. ft.

Coal.—The coal used throughout both of the trials was from Ravensworth Hurtley, Durham, and had a calorific value of 14,780 thermal units per lb., which is equivalent to the evaporation of 15·31b. of water from and at 212° F. per lb. of coal. In the trial without steam in any of the jackets, the total coal used was 2144lb. in 5·97 hours. This is equivalent to 3591b. per hour, or 6·01b. per minute, and to 10·31b. per square foot of grate area per hour. The quantity of clinker and ashes made during this trial was 1881b., equivalent to 8 8 per cent. of the total fuel. In the trial with steam in the two cylinder jackets the total coal used was 16801b. in 5·57 hours. This is equivalent to 3021b. per hour, or 5·01b. per minute, and to 8·61b. per square foot of grate area per hour. The quantity of clinker and ashes made during this trial was 2211b., equivalent to 13·2 per cent. of the total fuel.

Nos. 45 and 46. Experiments on the experimental engine at the City and Guilds of London Central Institution, South Kensington, by Professor W. Cawthorne Unwin.

Engine.—The engine on which the experiments were made is a two-cylinder horizontal surface-condensing experimental engine, capable of being worked either as a single-cylinder or a compound engine. It was made by Messrs. Marshall, Sons and Co., of Gainsborough, and was fully described and illustrated in "Engineering," 16th November, 1888, pp. 473—476. The diameters of the cylinders are 8·73in. and 15 76in., and their common stroke is 22in. The high-pressure cylinder is provided with Hartnell expansion gear, and the low-pressure with Meyer expansion gear. The bodies of the cylinders are covered externally with felt and teak, and the ends are bright and not covered. The experimental arrangements involve greater complication of steam pipes and consequent loss by radiation than is usual in ordinary engines. The engine is also at present worked at a steam pressure lower than that for which it was designed. The trials were made with a constant load on the brake.

Only the bodies and back ends of the cylinders are jacketed. The front ends and the receivers are not jacketed. Steam is supplied direct to the jackets by a separate pipe, and they are drained by gravitation into a reservoir under pressure, provided with a gauge glass. The following shows approximately the areas of the jacketed and unjacketed portions of the inner surfaces of the cylinders :—

Cylinder.	Area of Inner Surface.		
	Jacketed.	Unjacketed.	Total.
	sq. ft.	sq. ft.	sq. ft.
H.P.—			
Body....	3·95	0·90	4·85
Ends....	0·41	0·41	0·82
Total....	4·36	1·31	5·67
Per cent	76·9 p.c.	23·1 p.c.	100·0 p.c.
L.P.—			
Body....	7·04	2·15	9·19
Ends....	1·35	1·35	2·70
Total....	8·39	3·50	11·89
Per cent	70·6 p.c.	29·4 p.c.	100 0 p.c.

Two experiments—Nos. 45 and 46—were made on this engine, each consisting of two trials of about three hours' duration, with and without steam in the jackets. In Experiment No. 45 the engine was worked as a single-cylinder condensing engine, only the larger of the two cylinders being in use; in Experiment No. 46 both cylinders were used, and the engine was worked as a compound condensing engine. In the single-cylinder experiment (No. 45) there was a saving due to the steam jackets of 17·0 per cent. in the feed water, and in the compound experiment (No. 46) a saving of 7·3 per cent.

(*To be continued.*)

London Association of Foremen Engineers and Draughtsmen.

The usual monthly meeting of this association was held in the Cannon-street Hotel, on Saturday, the 3rd inst., at 7 p.m., when the president (Mr. Garnish) and the vice-president (Mr. Brown) occupied the chairs.

After the usual routine business, Mr. John Taylor gave a report of his visit to Newcastle on the occasion of the annual dinner of the association, and mentioned that he had been kindly treated, and given opportunities of seeing over some of the principal works in the district, and he was impressed with the number of empty berths he saw in the shipbuilding yards and the large numbers of men lounging about the streets, which denoted considerable depression of trade.

Mr. Taylor, as announced, afterwards read a paper on "Shipbuilding," which was illustrated by several large diagrams on the walls and many photographs of ships of various classes. Mr. Taylor described the development of our present system of shipbuilding, and gave particulars of the construction of some of our most recent vessels. He said that probably shipbuilding as an art had lost somewhat of its dignity in the process, but had gained a great deal in science, and that naval architects were now capable of designing ships to suit any requirements, and as a rule their productions came up to their expectations.

An interesting discussion took place after the reading of the paper, in which several of the members took part. Mr. Powrie said he thought our modern battleships exemplified in a remarkable degree the benefits derived from division of labour. A first-class man-of-war was now a collection of all that was best in shipbuilding, engineering, gunnery, and electrical science, and the marvellous progress made in those branches during the last 30 years could only have been attained by men of the highest intelligence devoting their energies to some special branch, and even if mistakes sometimes were made, he considered great credit due to those who designed and produced the results we now saw. Mr. Coates considered it was a great mistake for naval men to profess to rely on coal as a defence to the engine or boiler-rooms of our ships, as it was highly probable by the time a ship got fairly into action her coal bunkers would be nearly empty. He also thought more protection ought to be afforded to the guns and fighting gear generally, and believed that the whole armament of a cruiser would be disabled in a few minutes after going into action for want of protection on the upper deck. He thought the authorities were too anxious to make any ship capable of doing anything, with the result that they were packed with machinery of all kinds, and that it would be better if ships were built for special purposes. He thought the main purpose of a fighting ship ought to be to fight, and not to run away; but if the fighting gear was all disabled, there was no alternative but to make a straight course for the nearest friendly port. Mr. Reid referred to his experience as a seagoing engineer, and considered that the chief engineer of a ship should have supreme control over his own department, and those employed in it.

A vote of thanks was passed to Mr. Taylor for his interesting paper, which he acknowledged, and briefly replied to some of the criticisms, and the meeting closed.

Shipbuilding Notes.

On the 6th inst. there was launched by Messrs. John Fullerton and Co., from their yard at Paisley, an iron screw-steamer of 380 tons, built to the order of Messrs. J. and J. Hay, Glasgow. Compound engines are to be fitted by Messrs. Muir and Houston, Glasgow.

The new first-class gunboat "Jason," recently delivered from the Naval Construction and Armaments Company, underwent an eight hours' full-power trial of her machinery under natural draught at the mouth of the Thames on the 8th inst. The trial was attended with most successful results.

A new steamer for the Aberdeen Steam Navigation Company was launched from the yard of Messrs. Hall, Russell and Company, shipbuilders, Aberdeen, on the 6th inst. Her dimensions are :—Length, 262ft.; depth, 19ft. 6in. to main deck, with 33ft of beam. Her gross tonnage is 1250. The engines are triple-expansion, capable of indicating over 2000H.P.

On the 6th inst. there was launched from the shipbuilding yard of Messrs. M'Ilwaine and M'Coll, Belfast, the steel cruiser "Gorronommah," which has been built for the Free State of Liberia, and which is the first of the war vessels possessed by that State. The vessel is 95ft. long, and has an Admiralty displacement of 150 tons. She is to be armed with Nordenfelt and quick-firing machine guns.

On the 3rd inst. the steamer "Oakley," built by Messrs. Craig, Taylor and Co, Thornaby-on-Tees, was taken to sea for her trial trip, which proved highly satisfactory, a speed of about 12¼ knots being obtained. The vessel is of the following dimensions :—309ft. by 40ft. by 22ft. depth, moulded, and has triple-expansion engines, 22in., 35in., 57in. by 59in. stroke, by Messrs. Westgarth, English and Co., of Middlesbrough.

A torpedo gun vessel for H.M. Government was launched from Messrs. Laird Brothers' works, Birkenhead, on the 6th inst., and named the "Renard." The vessel has a length of 230ft., with a beam of 27ft. and a depth of 14·3ft., her displacement being 810 tons. She is propelled by two sets of independent triple-expansion engines, capable of developing 3500I.H.P., the cylinders being 22, 34, and 51in. in diameter by 21in. stroke, and working at a pressure of 150lb. The armament consists of two 4·7 guns, four 3-pounder guns and several torpedo tubes.

The cargo steamer "Huguenot," which has been built to the order of Messrs. Adolphus P. Harrison and Co., Newcastle-on-Tyne, was taken to sea on the 8th inst. for trial. An average speed of 11 knots per hour was attained after several runs on the measured mile. The principal dimensions are :—Length over all, 233ft. 3in.; breadth, 31ft.; depth moulded, 16ft. The engines, from the works of Messrs. George Clark Limited, Southwick, Sunderland, are on the triple-expansion system, and have cylinders 18in., 30in., and 49in. diameter, with a stroke of 33in.

On the 7th inst. the steamer 'Cragside, built by Messrs. Wood, Skinner and Co., of Bill Quay, Newcastle, left that firm's shipyard for the customary trial trip. The principal dimensions of the vessel are as follow :—Length, 168ft.; beam, 25ft. 6in.; depth (moulded), 12ft. 6in. The vessel is propelled by a set of triple-expansion engines, having cylinders 13, 21½, and 34in. diameter by 27in. stroke, which have been built and fitted by the North-Eastern Marine Engineering Company, Limited, at their Sunderland works, and which during the trial worked in a very satisfactory manner. During the trial over the measured mile a mean speed of ten knots was attained.

The new Russian battleship, "Dvienadzat Apostoloff," which was to have developed 8500H.P., and to have had a speed of 17 knots developed at her last trials only 8000H.P., and her utmost speed was 16·6 knots. This unsatisfactory result is attributed to the inexperience of the stokers and the badness of the coal. The other new battleship, "Gangoot," has not yet been tried, but is expected to develop 6000H.P. and 14 knots' speed with natural, and 9400H.P. and 16·7 knots speed with forced draught. She is to receive as her armament one 12in gun of 30 calibres, mounted forward in a 9in. compound turret; four 9in. guns of 35 calibres, mounted in 8in. casemates on the battery deck; four 6in. guns of 35 calibres; and four 3-pounder and 14 1-pounder Hotchkiss quick-firing guns.

Electric Pumping for Mines.*

As electricity has now established itself as a thoroughly reliable agent for the transmission of power for pumping, probably a *résumé* of the details of the arrangements necessary, with a few hints as to the management of the apparatus, may be of service to the readers of these columns. As will be now well known, the apparatus at the generating station, the place from which the power is transmitted, is very similar in character to that used for transmitting power by means of compressed air, the generating dynamo taking the place of the air compressor. The generating dynamo is now usually a compound-wound machine, similar to those used for electric lighting, except that it is constructed to work at from 300 volts to 500 volts, in place of the 100 to 110 volts that are usual for lighting only.

Incandescent lamps of any power from 16C.P. upwards are furnished with current by the same generating dynamo, and even by the same supply mains, the only difference in the arrangements being that in place of connecting each individual lamp directly to the two main cables, three, four, or five lamps of the same power are connected in series. As 100-volt lamps are usually employed at present in mines, three lamps must be connected in one set with a 300-volt service, four with a 400-volt service, and so on. Each series must be turned in and out together, unless an arrangement is made to bridge over any individual lamp, by means of a wire resistance, when it is not in use. This plan of bridging any lamp over, however, is hardly to be recommended, as it necessitates additional complication in the switches, and the bridges—the artificial resistances which take the place of the lamps—are very liable to be a source of trouble.

The plant at the pumping station is again very similar in character to that for a pump worked by compressed air, the motor dynamo in this case taking the place of the engine which is driven by the compressed air. The motor dynamo may again be simply a dynamo that could be used for electric lighting, or it may have some special features which its designer considers will improve its duty as a converter of energy. The almost universal practice—in this country at any rate—is to have an ordinary lighting dynamo, but series-wound, as arc lighting machines are, made to work with from 300 to 500 volts, in correspondence with the generator. If the ordinary series-wound dynamo is used, when a current is allowed to pass through it from an external source the armature of the dynamo will turn in the opposite direction to that in which it would have been turned had it been driven as a generator, so that the brushes must be arranged accordingly. The armature of a shunt-wound dynamo when used as a motor revolves in the same direction as when generating a current. Any given series-wound dynamo can be arranged to turn in the same direction as a motor as it would have turned when furnishing a current, by reversing the directions of the winding during construction. This is now hardly ever done, however, as it needlessly increases the stock that must be held by dynamo makers, and there is no difficulty in altering the position of the brushes to meet the reversed motion.

In the series-wound dynamo, as most of the readers of this article know, the windings of the field magnet wires are in series with those of the armature, the same current passing through each, so that every change in the current strength in every part of the circuit is felt by both armature and field magnets to approximately the same extent and in the same manner. In the series-wound dynamo a shunt or loop is taken from the brushes of the dynamo to furnish the magnetism of the field magnets. In the series-wound dynamo only a portion of the current which is generated by the armature, or which is brought to the dynamo by the cables, passes round the field magnets, so that any change in the current passing in the main circuit affects the armature and field magnet wires oppositely. Shunt-wound dynamos were used in the early days of electric pumping for generators in some cases, but they have now given way to the compound machine, the latter giving the engineer more complete command over his plant. The compound machine combines the two methods, shunt and series, part of the magnetism of the field magnets being furnished by thick wires which carry nearly the whole current passing through the machine, and the remainder by a loop or shunt wire, as in the shunt-wound machine. The great advantage of the compound machine is that as long as the speed remains uniform, the electromotive force at its terminals—or, if preferred, at some given spot at a distance from them—remains constant. On the other hand, by increasing or decreasing the speed at which the machine is being driven, the electromotive force can be increased or decreased at will. This last property is made use of to increase the work by the pumps, when required, say, by an inrush of water. The compound dynamo used as a motor should give uniform speed while dealing with varying loads. But this is of no value in pumping, as the easiest and almost the only way to increase the work done by any given pump is to drive it faster; and the only practical way of doing that when an electric motor is used is to allow the motor to run faster. This last is accomplished by increasing the electromotive force delivered at its terminals. Varying the speed of the generator and the whole electromotive force of the system has the disadvantage that some arrangement must be made for regulating the current passing to the lamps when any are used in connection with the pumping plant. If only a few lamps are required at the generating and motor stations, this is not a serious matter; but if the whole of the mine is lighted from the pumping plant, it is wiser to maintain the electromotive force at the highest voltage that is likely to be required, and to pass the current through an artificial regulating resistance on its way to the motor, so that the actual electromotive force arriving at the motor and the current passing through it may be varied according to requirements without altering the electromotive force at the generator. This plan has the disadvantage of wasting current and with it the coal required to be burnt in furnishing it, the efficiency of the system being thereby lowered, except when the plant is doing its full work. At collieries, however, this is not an important matter, and the value of the extra coal burnt is more than balanced by the increased convenience and the saving in lamps that would otherwise be destroyed by over-pressure. Where coal is an expensive item, if there are many lights to be furnished it would probably be wiser to have two plants, one for pumping and one for lighting.

The arrangements for connecting generator and motor also resemble those in use with compressed air, the difference being that where one large pipe is used with compressed air two smaller solid conductors are used for conveying the electric currents. But just as with compressed air it is pressure which is transmitted, and which causes the air to pass through the engine at the other end, so with electricity it is pressure or electromotive force which is transmitted, and which causes a current to pass through the dynamo at the pump and to make it revolve; just as the pressure is reduced also by the friction of the pipes through which the air is forced and by leakage of the air at joints, etc., so with electricity the pressure or voltage is reduced by the resistance of the cables and by any leakage currents that may be allowed.

With electrical transmission, however, we are able to calculate far more exactly what losses we may expect in transmission than with compressed air, and we can provide more certainly against leakage. The loss in any pair of cables between the generator and motor is measured by the formula

$$E = C R,$$

where E is the pressure or voltage lost in transmission, C the current passing in the circuit, and R the electrical resistance of the cables. Thus, if a current of 50 ampères be passing from the generator through the cables and motor while the resistance of the cables is equal to 0·5 ohm, we have

$$E = C R = 50 \times 0{\cdot}5 = 25 \text{ volts};$$

or, supposing the electromotive force at the terminals of the generator to be 500 volts, the other conditions as above, the electromotive force at the terminals of the motor when the current was passing through it would be 475 volts. Where, as may be arranged, two or more motors are worked from the same generator, the same cables supplying all for a certain distance, the fall or loss of electromotive force would be calculated for each section. Thus, suppose three pumps to be fed by one pair of cables to a certain point, where another pair of cables branched off to feed one of the motors, the main cable going on for the other two to another point where a second pair branched off, and then a third pair going on to the other pump. Let the resistances of the cables be 0·25 ohm up to the first branch, 0 25 ohm from there to first pump, 0·25 ohm from the same spot to the second branch, and 0 25 ohm for each of the others, the currents being, say, 60 ampères for the three pumps, or 20 ampères for each. The fall of E.M.F. to the first branch would be 15 volts, from there to the first pump 5 volts, making 20 volts between the generator and first pump, 10 volts between the first and second branches, making 25 volts to that point, 5 volts for each of the other two branches, making 30 volts each from the terminals of the generator.

It is usual to place an ampère-meter (an instrument for measuring the current strength passing in any circuit) and a voltmeter (an instrument for measuring the voltage, pressure, or electromotive force) at the generating station. It is also wise to have one of each at each pumping station. If a telephone can also be arranged between all the stations, as can easily be done in most cases, a simultaneous reading of the two sets of instruments forms a valuable check upon the state of the plant. Thus a heavy fall of electromotive force between the two, or a difference in the current strengths shown at the two stations, would be a sure sign that something was wrong with the cables. It is well to remember, however, that instruments are apt to vary amongst themselves and the same instrument from time to time, so that any increased difference only should be noted, and where there is any doubt the readings should be checked by a third instrument, or by changing the places of the two sets. But, assuming the instruments to be reading correctly, if the ampère-meter at the generating station shows a sudden or gradual increase, while that at the motor station shows either no change or a decrease, accompanied by an increased fall in the voltage, there is almost sure to be a heavy leak on the cables, which should be attended to without loss of time, or it may give a good deal of trouble. The cables used in a mine should always be highly insulated, and the more necessary is this the higher the electromotive force that is being used. India-rubber or Callendar's compound are the only two substances at present in use for the purpose, the latter more generally than the former. Gutta-percha has been used with success in the early days of electric lighting, but with heavy cables there is always the danger of the conductor working through the insulation. Whichever material is used, the outside of the cables should be well covered with at least two layers of jute and then with two layers of tape saturated with some waterproof material. It is necessary to keep the wet from any form of insulating material, or its electrical resistance is soon very considerably reduced and leakage currents result.

The problem of protecting the cables from fracture under falls of roof is also an important one. The general practice at present is to serve the cables, outside of the insulation, with one or two layers of galvanised iron wires, these being covered with a further braiding outside all. In the writer's opinion, for reasons which he hopes to give in another article, this arrangement is not a wise one. His view is that a sufficient thickness of jute would answer the purpose better than armour. Experience, however, will decide the question. The object of protecting the cable from fracture is, of course, not only to prevent the stoppage of the pumps, but also to avoid the possibility of the spark, which passes across the break, igniting gas if present. Messrs. Goolden and Co. have endeavoured to meet this by means of their safety cable. The advantage of using 300 or 500 volts in place of the 100 volts that are generally employed for lighting is that a very much smaller cable will carry the necessary current with the same loss.

The power delivered to the motor is measured by the product of the E.M.F. delivered at its terminals multiplied by the current passing through it when at work. Thus in the case given above, if the generator be working at 500 volts and be furnishing a current of 50 ampères, 25,000 watts (the watt being the unit of power) are being delivered to the cables; and if 475 volts be the electromotive force at the terminals of the motor, $475 \times 50 = 23{,}750$ watts are being delivered to the motor. Now, 25,000 watts being the power required at the generator, if only 100 volts pressure were used a current of 250 ampères would be required. A very much larger cable would be required to transmit this with the same heating effect on the conductor, and in addition, to make the loss of power the same as with the higher voltage—viz., $25 \times 50 = 1250$ watts, only a fall of 5 volts could be allowed between generator and motor. Using the formula given above, $E = C R$, but writing it $R = \frac{E}{C}$, we get R, the resistance the two cables must have $= \frac{5}{250} = \frac{1}{50}$ ohm, instead of $\frac{1}{2}$ ohm, or the cables must be twenty-five times as large. The cost of the cables need not be twenty-five times as great with the lower voltage as with the higher, as the insulation need not be so expensive, but the practice at the present time is not to make any difference between cables used for high and low voltages. Experience will prove again if this is wise; 746 of the watts referred to make 1H.P. The writer hoped to have dwelt with some other points in connection with this branch of the subject, but as this article has already extended to a greater length than he intended, he will deal with them on another occasion.

* By Sydney F. Walker, in the "Colliery Guardian."

Trade Notes.

Messrs. Russell and Co., Greenock, have contracted to build a sailing ship of 2400 tons measurement for a Nova Scotia firm.

The total output of gold in the Witwatersrand district of South Africa during the month of November amounted to 106,794oz.

Messrs. Neilson and Co., Hyde Park Locomotive Works, Glasgow, have secured an order for a number of heavy locomotives for India.

Messrs. Fellows and Bates, of Gorton, Manchester, have secured several important orders for paint machinery for Melbourne and New Zealand.

The Cape Copper Company Limited have declared a dividend of 1s. 2d. on the cumulative preference shares and of 1s. 3d. on the ordinary shares.

Messrs. J. Blakeborough and Sons, Brighouse, are supplying three 24in. sluice valves to the Waterworks Committee of the Manchester Corporation.

The Tubular Frame Wagon Company, Barrow-in-Furness, have booked an order from Costa Rica for a supply of wagons on the tubular frame principle.

Messrs. Perkins, Graham and Co., Manchester, have secured the contract for the construction of reservoirs, conduits, etc., for the Pemberton Local Board.

Messrs. Wallis and Steevens, Basingstoke, have received an order for a 10-ton steam road roller from the Llandudno Improvement Commissioners.

The directors of the Bristol Wagon and Carriage Works Company Limited have declared an interim dividend of 3 per cent. for the half-year ended September 30 last.

The Stanton Ironworks Company, near Nottingham, have contracted with the Rochdale Corporation to supply 1000 yards each of 3in. and 4in. cast-iron pipes, for use in the gasworks.

Messrs. John Barker and Sons Limited, of Oldham, have received several orders for hoists, cranes, etc. for several of the canal companies which are to be connected with the Ship Canal.

The contract for the supply of the condensing plant for the electric light plant at Bristol, which was placed with another firm, has now been given to Messrs. W. H. Allen and Co., Lambeth, London.

The directors of Messrs. Nettlefolds Limited have declared an interim dividend for the six months ended 30th September last at the rate of 5s. per share on the original preference shares, and of 10s. per share on the ordinary shares.

Messrs. Appleton, Burbey and Williamson, London, have secured an order for a complete electric plant and material for the Lagunas Syndicate Nitrate Mines in South America. The plant comprises engine duplicate dynamo for 200 incandescent lamps and some arc lamps, with switchboard and instruments complete.

Herr Kaulla's project for the extensions of the Angora line of railway is under consideration. The scheme provides for the construction of a line from Angora to Cesarea, a distance of some 400 kilometres, for which a guarantee is asked from the Government of 18,000 francs per kilometre; also for a further extension from Eskichair Point, on the Angora line, to Koniah, for which Herr Kaulla will be content with a guarantee of 14,000 francs per kilometre.

Readers of "The Mechanical World" are invited to send to the publisher of "Good Health," the new weekly paper devoted to food, drink, medicine and sanitation, for a parcel of specimen copies, which will be sent gratis and post free, for distribution among their friends at home and abroad. Address, 391, Strand, London, or New Bridge-street, Manchester.

Wheel cutter in metal only. Every description of gearing. R. CHIDLAW, 43, City-road, Manchester.

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Having regard to the enormous circulation of THE MECHANICAL WORLD, the Editor suggests that it is by far the best medium for the insertion of every kind of "Wanted" advertisement, and the price is only one halfpenny per word. The Editor will be glad if MECHANICAL WORLD readers will kindly bear this in mind as occasion arises.

Vertical Air Pumps and Air-pump Buckets.*

THE efficiency of the air pump attached to a condenser has an important relation to the economic and potential power that can be developed by the steam pressure, as the lower the pressure that can be made to expel the air and water, the less will be the resistance to the low-pressure piston of an engine, which the term "back-pressure" fitly describes; and, as affecting the terminal pressure in an engine, it limits the numbers of volumes to which the steam may be expanded.

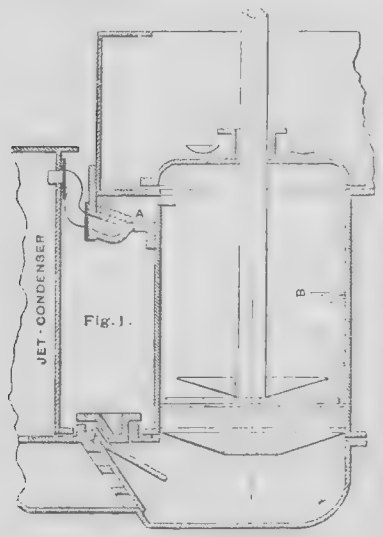


Fig. 1.

The number of times the terminal pressure will divide into the total initial pressure represents the total volumes to which the steam has been expanded in the engine. Therefore, the economic conditions desired for an engine will be to utilise this expansive power into work. The engine designer has for his object the solution of the problem to adjust his proportionate cylinder capacities to develop the whole of his steam power into piston movement, avoiding what is described as "idle expansions," or the "drop" of pressure in the receivers between the cylinders.

The steam cylinders and their valves, together with their valve gears, have been subjects of study to engineers for a long period of time, the result being a high degree of perfection in their construction, while upon air pumps but little attention has been bestowed heretofore. It is in this aspect of the case quite in the line of "progressive engineering" to consider the air pump and its design, in order to arrive at what shall constitute its best conditions as part of an economical engine.

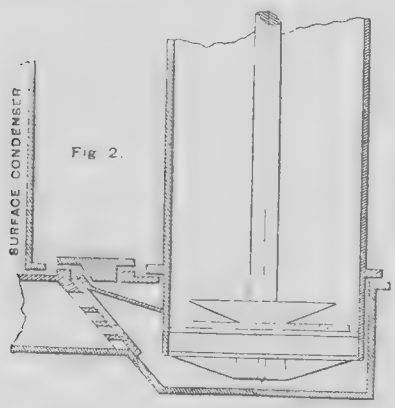


Fig. 2.

Bucket speed is important to arrive at in connection with the opening and closing of the valves in a given time; or, more to the point, to decide the lowest speed that may be given to the valve movements, it being plain that the condenser pressure ought to be kept at so low a point that its power to give motion to either the water or air must necessarily be feeble.

The surface condenser in its present perfection of detail gives but light work to its air pump. The water that passes through it is seldom in excess of the condensed water, because of the absence of leakage. This condition is a certainty. We have, therefore, the amount of water assured, but as air leakages cannot be entirely guarded against, the air to be pumped out is uncertain in amount, but not in a great degree, thanks to good workmanship and design.

The work done in an air pump attached to a jet condenser—see Fig. 1 (leaving out attachment A)—may be described thus:—

The bucket at its lower stroke-limit is found loaded with the water of the previous stroke. It ascends, to be followed by the water of condensation and injection (which is contained in channel-way and condenser), passing through the open foot-valves. The water follows the bucket until the condenser pressure is balanced by the hydrostatic column in air pump, the spaces below the bucket and behind the foot-valves meanwhile being filled with water and air. The instant the water stops in its upward flow the air behind it commences its upward movement into the space above the water-line, and follows the bucket to its upper stroke-limit.

This action is explained by the fact that the condenser pressure is not great enough to force the air downwards through the denser water; but the moment their relative

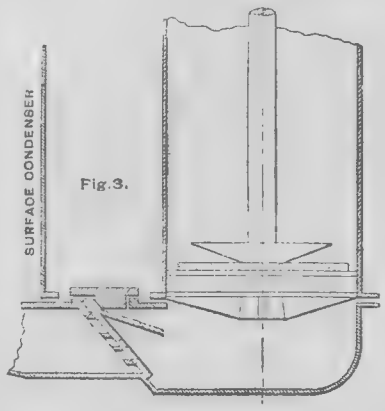


Fig. 3.

positions are reversed—that is, the water above and the air below—then gravitation operates to produce a free and rapid ascending air flow through the water.

To more readily appreciate the work done, we will assume the air pump shown by Fig. 1 to be 32in. diameter by 3ft. stroke, and attached to an engine of 1500I.H.P., with a steam cylinder, say 48in. diameter by 8ft. stroke of piston, and 30 revolutions per minute. Then 500lb. of water, approximately, would be pumped at each stroke, reaching to line B in the pump cylinder, or filling it about one-half, leaving the other half for the air. This will indicate that for surface condensation, where, proportionately, but 16 7-10lb. of water have to be pumped at each stroke, the capacity to pump out the air only needs to be considered.

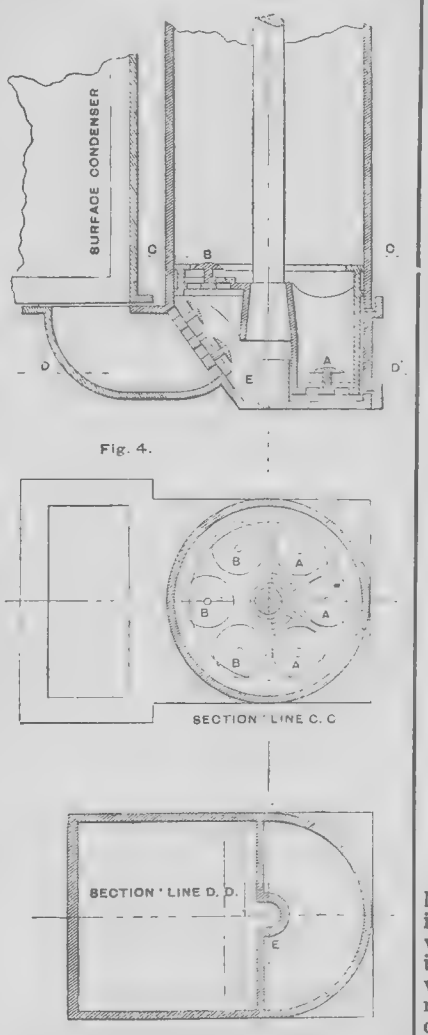


Fig. 4.

As the pump Fig. 1, at the given dimensions, is of $\frac{1}{4}$th the capacity of the steam cylinder, 1-12th the capacity would be proportionate for surface condensation. The above is merely an illustration, and is not correct as it is evident to engineers that the true proportion will be found nearer 1-16th capacity, with a preference for not over 25 strokes per minute. As a matter of course, the proportion holds good when the pump is attached to an engine, and when the revolutions are about 30 per minute. At 50 strokes per minute it becomes too high for the valves to function properly, and independent pumps are desirable. Then the revolutions, or cylindersful per minute, are to be taken into account. The capacities proportionately will then be from their cubical contents by their strokes, respectively.

Upon Fig. 1, at A, will be found an attachment applied to air pumps some years ago. The object was to relieve a jet condenser of the heated air close to its top, by opening the passage shown from

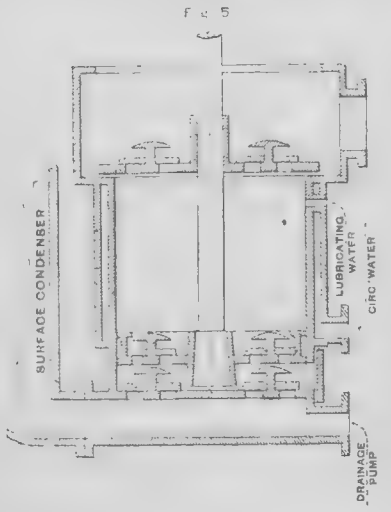


Fig. 5

there to the upper half of the air pump cylinder; but it will be plain, from the description given above of the working of an air pump, that no benefit was obtained, because it tended to equalise the pressures in pump and condenser sooner than desirable, and raise the condenser pressure correspondingly.

Figs. 2 and 3 are the usual air pump design for working beam engines. They are furnished generally but little reduced in size to those of the jet condensers, and are not in good proportion. Owing to the few strokes per minute, their large size does not materially affect the engine. Of course, the water they pump hardly covers the bucket-valve if carried at each stroke. This, however, does not occur as a fact. The water accumulates until it partially obstructs the passage of the air, and thus the discharges are intermittent, even at

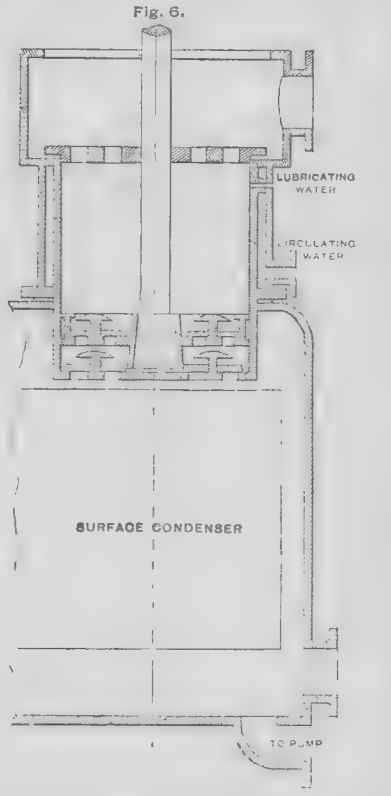


Fig. 6.

less than 30 strokes per minute. Fig. 4 illustrates a pump fitted with a bucket, which carries light loaded valves at B on its upper surface for passing the air, and valves A at the bottom of a prolongation made to reach close to the bottom of the channel-way, to immerse themselves into the water of condensation sufficiently to load the bucket with all of it at each stroke. To facilitate this, a bulkhead E crosses the channel-way, conforming to the shape of the bottom of the prolongation of the bucket, and forms a reservoir, which is intended to receive the condensed water.

The bucket, as shown in Fig. 4, carries itself constantly loaded with the water contained in the clearance space between bucket and head-valves. This loads the lower valves with an appreciable weight, and would require an equivalent condenser pressure to lift them, except that the lower part of the bucket compresses the water within the reservoir sufficiently for the contained water of condensation to rise and charge the bucket above the valves at each stroke. The impacted or dash-pot effect might be an objection were it not that this action takes place near the lower limit of the stroke, and where the downward movement nearly ceases. In this design there is always an unobstructed air passage from the condenser to above the bucket-valves, and as the water is mechanically loaded into the bucket and discharged at each stroke, there is a constant delivery of it as well as the air.

Fig. 5 shows a pump which, although some years in use, is probably but little known. As shown, it is intended to be an air pump pure and simple. The bucket, foot and head-valves are designed to have the minimum of clearance for best efficiency. The condensed water is carried away by a drainage pump, which perfectly drains the channel-way and delivers into a feed-water tank, which in this arrangement may be at any desired height without detriment to the condenser pressure.

Experience with this pump as first designed showed the necessity for lubrication by fresh water, which also served to seal the bucket and foot-valves air-tight, and, in addition, provision was made for circulating cooling water around the pump cylinder. It will be observed that in the event of the drainage pump failing to free the channel-way of water which might accumulate owing to leakage in quantity beyond its capacity, the air pump bucket then becomes the vehicle for its discharge, with no great rise of condenser pressure.

A novel arrangement is shown at Fig. 6. In converting a tug into a wrecking steamer, it became necessary to use the space occupied by the air-pump for the wrecking pump, resulting in placing the air pump on the top of the condenser and using a drainage pump, all as shown in Fig. 6. The difficulty that might present itself through leakages about the condenser, and thus overloading the drainage pump, was provided for by attaching the condenser to the water cylinder of the wrecking pump, but by careful workmanship and good management no occasion for its use existed during the few years the boat was above water.

As a matter of course, all engineers are familiar with the essential conditions necessary to a good working vertical air-pump. These are light and easy moving valves with liberal openings for air and water; the least possible clearance spaces between foot-valves, bucket-valves, and head-valves; all valves to be water-sealed against the atmosphere; no pressure upon head-valves by discharging above them; to use no more than 25 strokes per minute; to present no water-seal between air-pump and condenser; to make the shortest channel from condenser to pump. These are the principal requirements, all of which tend to a low condenser pressure and the beneficial influence upon the economic and potential results to be had from a steam engine.

Simplicity in Machine Design.

To the casual observer the operation of a complicated piece of mechanism will appear to embody a degree of ingenuity in proportion to its multiplicity of parts and functions. To the layman, at least, unskilled in matters of mechanical interest, this will apply, and naturally so, as he sees only the result and not the method of its conception. Provided the motion of each individual part is correct and all are in unison, the necessity of employing them is unquestioned, and the impression created is one of wondering admiration at the almost lifelike automaton. On the other hand, a machine for the accomplishment of precisely the same result, if of, say, one-half the number of parts and motions, would fail to excite notice or comment, on account of its simplicity—the very quality which renders it the more worthy of admiration.

The ingenuity and skill employed in its design would be in proportion as its equally perfect action was accomplished by a fewness of parts most nearly approaching the possible minimum. In most of the great mechanical inventions which have made the present century a notable era in the march of progress, the original conception was widely different from the fully-developed and successful machine. The former, while possibly capable of accomplishing the object for which it was designed, would do so in a roundabout way, and, owing to its unnecessary complication,

* By Miers Coryell, in the "Engineer," N.Y.

would be liable to derangement and wear in proportion—to say nothing of the increased expense of construction. But a careful study of its motions, and the means by which they were accomplished, would generally suggest the necessity for greater simplicity, and the crucial test of the ingenuity of the designer would be his degree of success as compared with the possibilities.

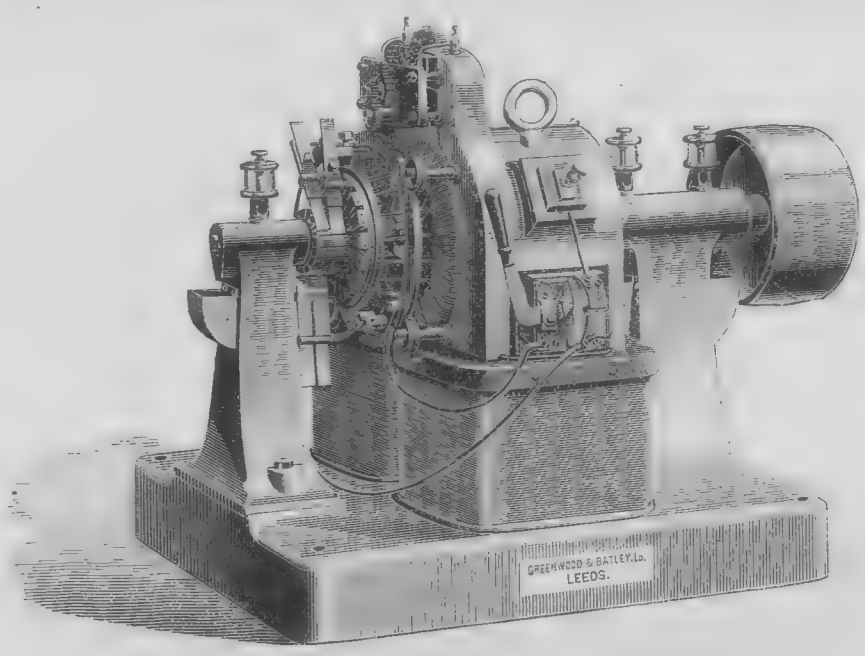
Each step in the simplifying process may in itself be a more ingenious achievement than was the original whole, and may be the result of more thought and study. Of course, where a machine is originally designed by a skilful and experienced engineer, it will be less likely to stand in need of subsequent development than it would be were it the work of an untrained inventor, whose lack of knowledge of correct mechanical principles and methods of construction had to be substituted by mere ingenuity. In the latter case, while the result might be most admirable as compared with the means for accomplishment, it would, almost inevitably, require to pass through the simplifying process to correct the crude and complicated devices of which it was the aggregation.

Real ingenuity is a natural and not an acquired faculty, and characterises the intellectual quality of its possessor. The habit of analysing causes and effects is spontaneous, and if not accompanied by too great an amount of egotism—which, unfortunately, is too often the case—will seek to avail itself of all possible means of increasing its store of information, not excepting the result of others' experience. To such minds the acquisition of the knowledge requisite for success is limited only by its opportunities, and mistakes will rarely be repeated in kind.

Naturally the result of continued effort and practice in mechanical matters will be the development of the inventor as well as his inventions, and he will become, by his roundabout course, an engineer of the most solid acquirements. One of the great mistakes of the impracticable inventor is that of being so well satisfied with his invention (and himself) that he can see no room nor necessity for simplification or improvement; and though his crude production may embody a valuable principle, he persistently stands in the way of its development, and it is lost, so far as practical profit is concerned, both to himself and the public, for want of a supplemental application of the ingenuity of simplicity.—"Iron Age."

The Leeds Arc Light System.

JUDGING by the scant display at recent electrical exhibitions, one is led to the conviction that there are still only two or three important types of arc dynamos for series lighting, and that these have experienced little, if any, improvements during the past few years. In all probability these machines are as perfect as their peculiar design and construction warrant; but it is of the rarest occurrence that results of tests with such dynamos are placed before the public. Of compound wound and shunt wound dynamos for incandescent lighting or for running arc lights in parallel there are innumerable types in the market, all claiming the highest possible efficiency. Arc lamps are, as a rule, only used for the lighting of streets, large open spaces, public buildings, and factories possessing lofty rooms. In such cases the distribution of the current to the lamps, if placed "in parallel," involves a capital outlay for copper leads often exceeding in cost the value of the electric generators and lamps combined, even when allowing a very considerable loss of energy in transmission. These facts are well known to electrical engineers, and, wherever possible, "series" arc lighting is resorted to for economic reasons. The following is a short description of a system of "series" arc lighting evolved by one of the best-known engineering firms in the kingdom, Messrs. Greenwood and Batley Limited, of Leeds, who have spared no pains in producing a highly-efficient, compact, and economical apparatus, which only requires to be seen in order to be fully appreciated. Fig. 1 shows the general arrangement of a 20-light dynamo, with the regulating gear attached. By Fig. 2 we can trace the circuit represented in diagrammatic form. The field magnet poles of the dynamo have two small projections, which serve as a magnetic field to a little flat ring armature M, which is provided with an ordinary commutator and a pair of brushes, receiving a weak current through an automatic reversing switch. This switch consists of an electro-magnet energised by the main current, an armature L, which can make contact with either of the terminals *a* and *b*, and two resistances R, consisting of carbon rods about ½in. in diameter and some 6in. long. The slightest variation of the electromotive force in the main circuit will cause the armature L to make contact through *a* or *b*, as the case may be, and send a current through the armature M in one direction or the other, and thus cause the latter to revolve forwards or backwards. By virtue of this rotation of M the circular rack S supporting the brush-holders of the dynamo will move slowly (it being driven through a small train of wheels geared to the spindle of M), and thus adjust the position of the dynamo brushes to suit the electromotive force demanded by any number of arc lamps arranged in series. Contrary to the expectations of some electrical experts, there is no "hunting" in the regulating gear. The energy used in actuating it was exceedingly small, and the efficiency of the whole machine at various loads remarkably high. The following tests, made on a 20-light machine, will show this most clearly. The machine was driven by an electric motor, the brake horse-power of which was easily ascertained, running at a constant speed of 750 revolutions per minute. The current was constantly at 10 ampères, and the average voltage measured 47 volts per lamp.

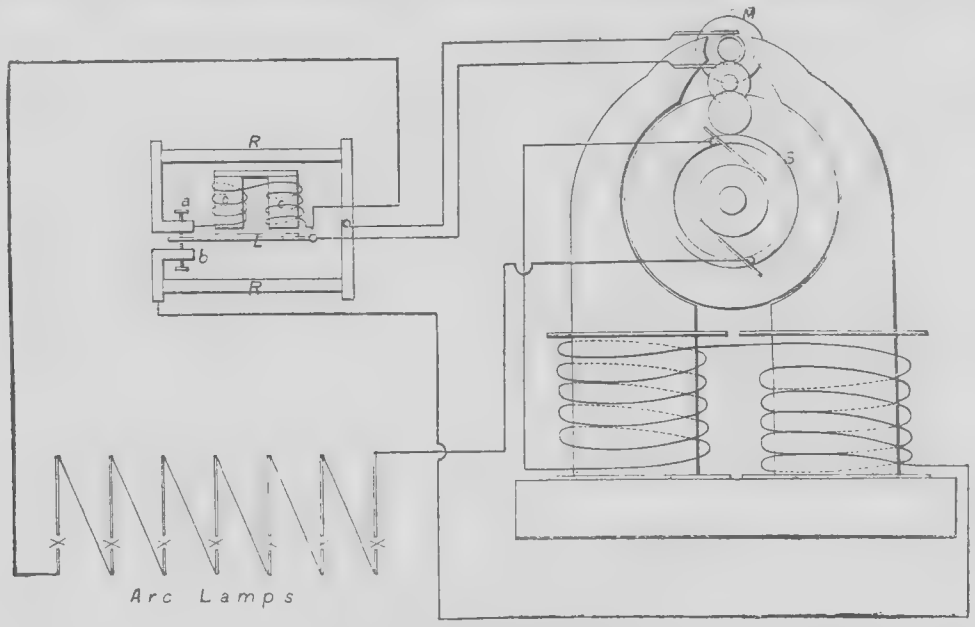


LEEDS ARC LIGHT SYSTEM.—FIG. 1.

TESTS OF THE LEEDS ARC DYNAMOS.

No. of lamps. 2000 N.C.P.	Speed. Revolutions per minute.	Current. Ampères.	Brake H.P. absorbed.
5	750	10	6·31
6	750	10	6·98
8	750	10	7·81
12	750	10	10·65
16	750	10	13·1
20	750	10	15·2

The regulator absorbs only 21 watts, or about ¼ per cent. of the maximum load—quite a negligible quantity. There is no sparking at the contact maker, and, when once adjusted, the automatic regulator will act promptly, and without any further attention except an occasional dusting. By the Leeds arc light system it is possible to run incandescent lamps in series with arc lamps. Such incandescent lamps, of course, must use the same current as the arc lamps, and they are fitted with holders and switches to be put in and out at will. The economy, simplicity, and utility of having both arc and incandescent lamps run in series from the same dynamo will be appreciated, especially in such cases as the lighting of mills, factories, and public halls, where the greater part of the lighting is done by means of arc lamps, but where a few incandescent lamps would be useful in offices and rooms forming part of the premises.



LEEDS ARC LIGHT SYSTEM.—FIG. 2.

Society of Engineers.

AT a meeting of the Society of Engineers, held at the Town Hall, Westminster, on Monday evening, the 5th inst., Mr. Joseph William Wilson, jun., president, in the chair, a paper was read by Mr. A. G. Drury on "The Shortlands and Nunhead Railway."

The paper commenced by stating that the line was promoted by several landowners for the purpose of further developing their estates, they being also joined by the L.C. and D. Railway Company, who by means of the new branch have obtained an alternate route into the metropolis. The railway, which is a double line, commences by a junction with the Chatham Company's main line at Shortlands, passes through open country for the first half of its length, then runs through the suburbs of Catford and Brockley, and terminates by a junction with the Chatham Company's Greenwich branch at Nunhead station, having crossed a branch of the S.E. Railway, as well as the L.B. and S.C. Railway's main line, on the route. The length is 4¾ miles, and considering the short distance from London, the amount of house property interfered with is very small.

Attention was drawn to the fact that the line, having been planned to suit the views of the landowners, has not been laid out perhaps in the best way from an engineering point of view; also that, as some of the estates passed through are about to be developed as first-class building properties, the accommodation bridges are both frequent and of a width or span suitable to the present and future requirements. The elevations, too, are of a more or less ornamental character, all of which requirements have added considerably to the cost of the undertaking.

In alluding to the earthworks, a slip which occurred in the Shortlands cutting was described. A portion of the cutting had been trimmed with a slope of 2 to 1, when after a period of wet weather the material broke away and slid forward on a bed of stiff clay which dipped down towards the cutting. To repair it a deep grip was cut round the back of the slip and pipes laid to intercept the water and carry it round to the ends of the clay bed, after which a dwarf wall of concrete was built in front to support the toe of the slipped material and to prevent its coming any further.

The works were briefly described, the number of bridges in the length being 25, in addition to 2 short viaducts. Six of these bridges are for public road crossings, 2 are over other railways, 2 are over streams, and 15 are accommodation bridges.

Brickwork and concrete has been used in the construction of the abutments and wing walls, the brickwork being in lias lime mortar except in the case of arches or in damp situations, when cement mortar was used. The road bridges over the railway are chiefly of two types. One consists of a floor of plate girders resting on brick abutments, and spaced from 6 to 7ft. apart. Between the girders are jack arches, which spring from their lower flanges. The top is levelled up with concrete and asphalted, the road

metalling being laid above this. This type was adopted as there was not sufficient headway available for arched bridges. When the headway was very restricted, another type of floor was adopted, which consisted of shallow troughs of a rectangular section, built with plates and 2in. bars, and placed parallel with the roadway. In this case the span was divided by columns placed between the lines of rails

The road bridges under the railway consist of plate girders resting on brick abutments, with a floor of built-up troughs similar to those referred to above. The transverse sleepers of the permanent way rest on ballast in the troughs, and are surrounded with ballast to deaden the sound of passing trains as much as possible. This construction was also adopted partly on account of restricted headway. These bridges being for a double line of rails, the use of shallow troughs necessitated three main girders, one being placed in the six-foot way. This centre girder has been kept at platform height, and in places where the span was more than about 50ft., columns have been introduced in order that the height of the girders might be kept within the prescribed limit. The columns stand at the edges of the footways to the roads below.

In conclusion, some information was given as to the cost of the works. The works have been carried out under the direction of Mr. John Wolfe-Barry, M. Inst. C.E., the author acting as resident engineer in charge. The contractors were Messrs. Lucas and Aird, who were represented on the ground by Mr. John Blue, and latterly by Mr. Charles F. Day.

Metal Trade Memoranda.

The output of ore from the Marbella Iron Ore Company's mines during the month of November was 3800 tons.

Mr. H. C. French, of Buffalo, U.S.A., recently consigned 200 tons of pig iron to the Lees Malleable Casting Company of Derby.

The Government of New South Wales recently asked for tenders for the manufacture of 175,000 tons of steel rails within the colony, but only one tender has been sent in.

The Arizona Copper Company's mines during the month of November produced 248 tons of black copper and 82 tons of matte. This is equivalent to about 305 tons of black copper.

The export of tinplates from Swansea during the week ending December 3 reached the unusually large amount of 120,331 boxes, reducing the stocks from 210,450 boxes to 165,920 boxes, notwithstanding that 76,098 boxes were received from manufacturers.

The tubemakers in the Glasgow district have decided to make no change in the discount, which remains at 68¾ and 5 per cent. for Clyde delivery, and 67½ and 5 per cent. for other districts. Makers report a better demand for tubes, and they are now all able to keep working single shift. A number of the gas tubemakers are said to be very busy, and working double shifts.

The Metal Market.

PRICES CURRENT.

LONDON, DEC. 12.

COPPER opened firm and 2s. 6d. better, with 10 weeks placed at £47 17s. 6d., and prices further advanced, £47 10s. cash and £48 three months being paid, the rise being due to higher New York cables and buying on American account. Future positions then eased off. £47 16s. 3d. being taken for ten weeks, and £47 18s 9d. three months, but cash being scarce, ruled firm at £47 10s. In the afternoon, under realisations, cash declined to £47 8s. 9d., and on the kerb £47 16s. 3d. was accepted for a few days short of three months, the close being steady at an advance of 1s 3d. for cash, while three months was unchanged. Sales, 600 tons. Settlement price, £47 7s. 6d. English tough, £51 to £51 10s. Best selected, £52 to £52 10s. Strong sheets, £60.

TIN opened strong at about 12s. 6d. advance, owing to Continental buying, £93 being paid for one month. Later on £92 15s. was taken for January prompt, but on consumers buying, an early prompt made £93 2s. 6d. Future positions remained easier, and, in order to realise the advance, £93 cash was accepted towards the close, and finally, after the official finish, three months changed hands at £92 12s. 6d. The close is steady and 12s. 6d. to 15s. higher than Friday. Sales, 70 tons Settlement price, £93. English ingots, £96 to £96 10s.

PIG IRON ruled dull during early trading, with buyers 2d. below Friday's closing values, but in the afternoon, holders being more disposed to operate, business was done at 41s. 9d. for Scotch 15 days, and 41s. 8d. cash, 1500 tons changing hands and the close is quiet at 2d. loss for Scotch on the day, but otherwise values were unchanged. Settlement prices:—Scotch 41s. 8d.; Middlesbrough, 37s 4d; hematite, 46s.

TINPLATES dull and unchanged. I.C. cokes, f.o.b. London, 12s. 9d.; Liverpool, 12s. 3d.; Swansea, 11s. 9d.

LEAD is flat, with Spanish offering at £9 17s. 6d. English, £10.

SPELTER is extremely dull, and December shipment is available at £18 5s., a decline of 5s. on ordinary brands.

ZINC SHEETS.—Silesian ordinary are flat and 5s. lower at £21 10s. sellers ex ship. Belgian quiet but steady—V.M. brands, ex ship, £22 2s. 6d., and f.o.b. Antwerp, £21 17s. 6d. to £22.

OFFICIAL CLOSING QUOTATIONS.

	To-day.					
COPPER—	£	s.	d.	£	s	d.
G. M. B.—Cash	47	8	9	47	16	3
" Three months	47	17	6	48	5	0
English rough		—	—		—	
Best selected		—	—		—	
Strong sheets		—	—		—	
TIN—						
Fine foreign—Cash	93	0	0	93	10	0
" " Three months	92	15	0	93	5	0
Australian—Cash	94	10	0	95	0	0
PIG IRON—					s.	d.
Scotch warrants—Cash					41	8
" One month					41	0½
Middlesbrough—Cash					37	4½
" One month					—	
Hematite—Cash					46	0
" One month					—	

Official Gazette.

Partnerships Dissolved.

H. KENYON and D. TINNION, under the style of H. Kenyon and Co., Warrington, spelter manufacturers.

D. CAMPBELL, J. H. TOZER, G. L. SCHULTZ, and W. TOZER, under the style of Schultz, Tozer and Co., Eastcheap, City, engineers and merchants.

A. W. FARMER and J. S. FARMER, under the style of Sir J. Farmer and Sons, Salford, engineers.

W. JACKSON and T. TOWNEND, under the style of Jackson and Townend, Rochdale, engine packing manufacturers.

THE BANKRUPTCY ACTS, 1883 AND 1890.

Receiving Order.

H. J. LICHTENSTEIN and G. BREEZE, trading as the Alliance Iron Company, Upper Thames-street, City, iron merchants.

Adjudication.

R. BAILLIE, late trading as Westwood, Baillie and Co., London-yard, Poplar, shipbuilder.

New Companies.

EFFINGHAM STEEL WORKS AND ROLLING MILLS COMPANY LIMITED.—This company has been registered with a capital of £5000, divided into 500 shares of £10 each, to enter into and carry into effect a certain agreement, and to carry on the business of manufacturers of crinoline, stay busk, and watch-spring steel and hot and cold rollers of iron and steel, and of ironfounders, mechanical engineers, toolmakers, metal workers, brassfounders, and millwrights. With slight alterations the regulations of Table A apply. Registered by Mr. Charles Doubble, 14, Serjeant's Inn, E.C.

LONDON SMELTING WORKS LIMITED.—This company was registered on the 2nd inst., with a capital of £5000, divided into 5000 shares of £1 each, to enter into and carry into effect a certain agreement which has already been prepared, and to carry on the business of metallurgists, smelters, assayers, spelter manufacturers, and engineers in all their respective branches. Registered, without articles of association, by Messrs. Stevenson and Couldwell, 193, Gracechurch-street, E.C.

Trade Marks.

The following is the Official List of Applications published from November 30 to December 7 for the Registration of Trade Marks, so far as relates to the Metal Trades.

CLASS 4.

SHALAGO

167,670. Ironfounders' blacking used for metal castings IRONFOUNDERS' GRINDING COMPANY, 3, West Scotland-street, Glasgow; blacking manufacturers.—12th October, 1892.

Letters to the Editor.

*** *We do not hold ourselves responsible for opinions expressed by correspondents.*

*** *The name and address of the writer (not necessarily for publication) must in all cases accompany letters intended for insertion, or containing queries.*

*** *Letters intended for publication in the current week's issue must reach our Manchester Office not later than by the first post on the Tuesday preceding the date of publication.*

AMERICAN AND BRITISH WORKMEN AND MACHINERY.

To the Editor of THE MECHANICAL WORLD.

SIR,—The author of the article which appeared in your issue of the 9th inst. has evidently visited this country with a view of picking up information as regards the engineering trade. As he has made an attack on the working men of this country, I should like, with your permission, to say a few words in defence of our workmen.

(1.) "A given number of American mechanics will build over twice as many locomotives per year as the same number would in Britain." Now, the reply I shall give to that statement is that the English-made locomotives have twice as much work in them as the American engine. The faces are scraped up true, and all parts are made a sliding fit. In American practice they are left to grind to a fit, and whilst working they consequently need more oil and overhauling than our locomotives. Superior workmanship, together with a sound-running job, gives us the pull over our American cousins.

(2.) Our pay, considering the advantages of cheap food and clothing and certain privileges, is fully equal to the pay of the American workman.

(3.) With regard to the easy swing of the British workmen as compared to the greater activity and push of the American, I would say there is more activity in the British workman as far as regards work when he is put to the test. We do not claim to push ourselves into our employers' shoes, which, from the author's remarks, I should think he would do.

(4.) By questioning British workmen the author is impressed with the stolid carelessness in answering questions, partly from ignorance and partly from a fear of knowing too much for their places. No doubt every workman regards (as I do) with very great suspicion anyone in broadcloth coming up to him in the shop and asking questions. Some people are so well informed that no workman could answer any question they put. To those I would say: Be very careful, as some workmen are well informed in most subjects relating to engineering. We have ample time to study after our work is over, and a great many men avail themselves of this opportunity. Our cousin evidently expected to pick up information gratis which our employers have had to spend thousands of pounds in procuring, and if we were to give particulars of this kind we should soon be dismissed. In these days of keen competition the workman has to guard himself against anyone procuring any information through him as regards the trade which means loss of work for the employer and employé.

(5.) Our cousin wants us, instead of being thrifty, to spend our money on clothes, to come from our work in such as he wears, and our employers to provide us with soap, towels, and a comb and brush, as if we were ashamed of our black hands and faces. To this I say: We need never be ashamed of our calling. We do not wear the same clothes all the year round, or wear those advertised for working men. We keep ourselves as respectable as our station in life will permit.

(6.) Where is the disgrace of carrying our coffee can? Surely the Americans must dine at first-class restaurants, etc.

In concluding, I should like very much to have a biography of Mr. James Arthur. No doubt the working-man would reap some benefit from the career of one who so nobly defends his countrymen. His knowledge of English locomotive practice is very vague. If he is an engineer, he is not very conversant with the duties of an engine-tenter when he asks him whether he has taken cards from the engine, a duty which is not performed by a man simply tenting an engine. If we are put to the test, we can prove ourselves superior to the Americans.

A WORKING-MAN.

Fleetwood, Dec. 11.

Miscellaneous Items.

Electricity in its various forms is computed to give employment to 5,000,000 persons.

It is stated that an Edison electric-lighting plant is to be put down in Canton, China.

The highest chimney on the European Continent is at Freiburg, in Saxony, the shaft being 466ft. from its foundation.

A detailed survey of fifty miles of the Beira railway, South Africa, has been completed, and 16 miles of earthworks. Thirty-five miles will be completed by Christmas.

A monument has been erected at Heil-bronn to Julius Robert Mayer, who, contemporaneously with Joule in England, was a discoverer of the mechanical equivalent of heat.

The new Orient Line twin screw steamer "Ophir," which has arrived at Plymouth, made the shortest passage on record between Australia and England. She left Albany on the 5th November, and her voyage, including all stoppages, took only 28 days 10 hours, land to land.

The new first-class sleeping cars of the express service between Christiania and Copenhagen, and *vice versa* (across the Sound), are lighted by the electric light. The lamps are movable, being attached to a tube, and may be fixed in any position. These new cars equal in comfort any running on the Continent.

The Midland Railway Company have fitted two express trains running between London and Bedford with apparatus for warming the compartments by means of hot water. Continuous pipes are attached to each carriage throughout the train, and are supplied with hot water from the engine. The results are very satisfactory.

A scheme has been drawn up for the construction of an electric tramway between Benevento and Cancello, Italy. It is proposed to utilise the Falls of the Serino, near Arparà, in the generation of the current.

The directors of the Great Eastern Railway Company have decided to abolish, from the beginning of next year, second-class carriages on all their trains except those in the suburban district of London and the London and Harwich Continental trains.

At Erroll the other day the telephone linemen were called to repair a break. The wire had been fused by lightning, and on one of the white insulators the workmen, it is said, found a distinct picture of the roof of a neighbouring house, the picture evidently having been flashed on the porcelain by the lightning.

A large find of coal has been made at St. Helen's Colliery, near Workington. The area of coal found is about 1300 acres. In this area there are three or four seams, the total thickness of which is nearly 6yds. In a year or two it is expected the output of the colliery will, owing to the discovery, be double what it is at present.

The annual general meeting of the Man-chester Association of Engineers was held at the Grand Hotel, Manchester, on Saturday, the 10th inst., Mr. G. B. Goodfellow, president, in the chair. A number of new members having been elected, Mr. T. Daniels was unanimously chosen as president of the association for the ensuing year, and the other officers were reappointed. An amendment to one of the rules relating to the mode of electing candidates for membership was proposed by Mr. J. Nasmith, but by a majority it was resolved, on the motion of Mr. Daniels, to defer action in the matter pending the production of further information, which the Council were asked to supply. A vote of thanks was heartily accorded to Mr. Goodfellow for his conduct as president during the past year.

At the Colonial College, Hollesley Bay Suffolk, a rather large earthwork contract is just nearing its completion. The directors having decided to level a broad piece of ground the whole length of the college, and to throw up the excavated material into a terrace and terrace walk as a piece of landscape gardening, the work was enthusiastically taken up by the students of the college, to whom it was let in sub-contracts. The resident professor of engineering, Mr. T. Johnstone Bourne, A.M.I.C.E., and his classes undertook the levelling and measurement of earthwork, and they and other students have now completed about three-quarters of the work in a very satisfactory manner. The head gardener of the college, Mr. John Wolton, has superintended the work from a horticultural point of view, for which a previous experience at Sudborne Hall well fits him. The college workshops were able to produce all the plant necessary for the undertaking, and in this way again afforded good experience to the budding colonists.

Queries.

☞ Readers are invited to avail themselves of this section for practical information on questions relating to Mechanical Engineering and the Scientific Industries.

☞ Queries and Replies should arrive at the Manchester Office not later than by the first post on the Tuesday preceding the date of publication.

PLOUGH BREASTS.—Can any reader inform me the best way to grind cast-iron plough breasts? —T. W.

FILTRATION.—Will any reader state the best method of filtering 150 gallons of canal water per day for steam-boiler purposes?—T. H. MITCHELL.

CONVERTING GAS ENGINES.—Will any reader kindly inform me how to convert a Crossley's gas engine, 15H.P., slide-valve type, to a tube firing type?—FITTER.

SWEDISH BESSEMER STEEL.—Can any reader inform me how Swedish Bessemer steel is made, and also give highest amount of carbon it contains?—FORGEMAN.

COATING FOR WATER PIPES.—Can any reader tell me how to ascertain whether cast-iron pipes have been properly coated with Dr. Smith's solution?—WATER PIPE.

WRAPPING FOR WATER PIPES.—Can any reader inform me where I can procure slagg wool with canvas backing, specially made in strips, for wrapping water pipes?—W. L. K.

BLUE PRINTING.—Can any reader kindly inform me what the necessary mixture for *extra rapid* ferro-prussiate sensitising fluid is made from, and the quantities?—FOUNDRY.

"GRASS" PACKING.—Can any reader supply me with the address of manufacturers of this packing? I have seen it used for the piston and valve rods of L. and N.-W. railway engines.

SPEED OF LOCOMOTIVES.—Provided a railway line is laid as perfect as possible, can any engine attain such a velocity as to cause it to leave the rails owing to excessive speed only?—P. T. G.

TWIST DRILL CUTTERS.—Can any reader give me a method of getting the correct thickness and shape of cutter for any diameter of twist drill, straight lip? A drawing will greatly oblige.—J. M. F.

PETROLEUM.—Will any chemical correspondent kindly inform me what is the chemical constituent in petroleum that causes it generally to give off such an objectionable odour, and also by what means it is deodorised?—ODOUR.

PRESSED PAPER.—I shall be obliged if any reader can furnish me with names of firms in England or abroad who press paper for making trays, wheels, teeth, etc., and the widening circle of articles now made of compressed paper or pulp.—A CONSTANT READER.

IRON MIXTURE.—Would "Foreman Pattern Maker" kindly inform me whether his mixture for chilled hammer heads would do for chilled rolls; if not, would he kindly give one.—M ULDER?

HINTS TO DRAUGHTSMEN.—A Reader will be obliged if the author of "Hints to Young Draughtsmen" (November 18) will give a few hints for making the "nut and bolt and gas thread gauges." Where may a copy of the German round writing be had?—S. H.

GRINDING VALVES.—Will any reader advise me as to the best means of scouring brass valves and seats to a smooth face? I have tried flour emery, and a fast speed, but as I get at times different mixtures of metal in the valve and seat, I cannot smooth them both together.—W. THOMAS.

TUBE MANDRELS.—Can any reader inform me the best way to steady while turning, and also to lap when turned, a mandrel ¾in. × 7ft. long, to be lapped with $\frac{1}{1000}$ of taper in the whole length? I should also like to know the price per foot for the same.—TURNER.

LOSSES IN STEEL FURNACES.—Could any reader kindly inform me the average per cent. of actual loss, and the average per cent. of skull, in the charge of a Siemens open-hearth steel furnace working charges of from 30 to 40 tons? And also the percentage of loss in heating slabs and ingots in the Siemens regenerative gas furnace?—J. R. R.

Replies.

☞ Owing to the constant increase in our correspondence, we regret that we have no alternative but to announce that we cannot reply by post to Queries even when stamped envelopes are sent.

☞ Queries and Replies must in all cases be accompanied by the names and addresses of the writers, as no notice will be taken of anonymous communications.

W. D. G.—No address given.

OUTSIDE CALIPER.—The curve is a purely fancy one.

H. GRAHAM.—Many thanks for your kind letter. It shall have our attention.

CHAS. J. GRAY.—The value given in our Pocket Diary is quite correct.

ONE IN A FIX.—Mr. Wm. Bown, Birmingham, or the Rudge Cycle Company, Coventry.

INDICATOR.—Specially enamelled paper is used, but good smooth drawing paper will answer almost as well.

H. W. G. H.—We should think the "Colliery Manager's Handbook" (28s.) will suit you. It may be had from our office.

COUNTRY SMITH.—Your query is too elementary for insertion. Read Hasluck's "Model Engineer's Handybook." 2s.

T. GRANT.—Messrs. J. Sutcliffe and Sons, Halifax, will, we think, be able to give you full particulars of cork-cutting machines.

FLY-WHEEL.—You will find the engine run quicker when you have changed the pulley. The governor must be altered to finally adjust the speed as desired.

PUZZLED.—The port areas will depend upon the piston speed, which you do not give. See "The Mechanical World Pocket Diary" for 1893, which is *not* out of print.

JAMES GAMBLE.—Almost any maker of philosophical instruments will supply you. You might apply to Mr. Caplatzi, of Cheniesstreet, Tottenham Court-road, London.

W. PENNUCK.—You do not give sufficient particulars. We would advise you to procure "The Metal Worker's Handybook of Receipts," by Brannt. (Sampson Low.)

J. LEVER.—You will find full particulars in our issue for April 19, 1890. You must alter your gearing if you wish to retain your present engine, or else increase your steam pressure.

MANY YEARS SUBSCRIBER.—Is the engine to which you refer situated on a lower level than the other? Have you sufficient boiler power? Which engine is nearest to the steam supply?

R. GUNT AND SONS.—Messrs. Wm. Reid, 112, Fenchurch-street, London, are the makers of the automatic pressure reducing valve referred to, and they will give you full particulars upon application.

EJECTOR.—(1.) You would not obtain any vacuum unless you condensed your steam. (2.) The centrifugal pump would be very inefficient as a vapour pump and you would find it advantageous to use a mechanical blower or fan.

T. LAW.—The Crosby indicator may be had from the Crosby Steam Gage and Valve Company, 75, Queen Victoria-street, London; the Tabor indicator from the Globe Engineering Company Limited, 38, Victoria Buildings, Manchester.

E. G.—Cranks placed as you describe will not give such regular turning as if placed at right angles. As to whether you would gain in economy depends greatly upon the volume of the pipe between the cylinders which forms the receiver. Taking the volume of the air pump at one-fifth the volume of the L.P. cylinder, its diameter should be 20in. We think it would be an improvement to increase the overflow area as you suggest.

CONSTANT READER.—Your stroke is 20in. = 1·66ft., so that the piston speed is 1·66 × 2 × 95 = 316ft. per minute. From the table given in "The Mechanical World Pocket Diary" for 1893 (page 41) we find that for a piston speed of 300ft. per minute the diameter of the steam pipe = diameter of piston × 0·224, and the diameter of the exhaust pipe = diameter of piston × 0·272; so that the steam pipe should be 2·68, say 2¾in., and the exhaust 3·26, say 3¼in. diameter.

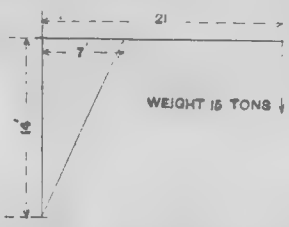
IRON MIXTURE.—Can any reader supply a mixture for steam hammer heads (chilled)?—TYRO.—*A.*—You will find it best to cast your hammer heads of pure hæmatite, and chill in the usual way. They will be found superior for the purpose to any mixture you can make. This is the best material in my experience, and will be found to give good results.—G. A.

SPEED OF DRIVE CHAIN.—Can any reader give me any particulars as to the safe speed at which Ewart's patent chain may be run?—SECOND MOTION.—*A.*—The makers give a table of the speed of their chains from 100ft. to 1000ft. per minute. This latter, I should say, was the maximum speed for a drive chain. At any higher speed the rattle and noise would be objectionable under most circumstances.—G. A.—Any speed up to 1500ft. per minute. Faster speeds have been adopted in special cases, but it is not advisable to trust to much more than 800 or 1000ft. per minute.—J. W. H.

SEA-GOING ENGINEER.—(1.) What are the qualifications and experience necessary to become third engineer on an ocean going steamer, passenger or merchant service? and (2.) Whether it is necessary to serve in a marine engineering shop previous to going out?—MARINE.—*A.*—See answer to "A. G. K.," in THE MECHANICAL WORLD, October 14th, 1892. The qualifications are those of a capable fitter who understands use of tools, construction, working, and repair of steam engines of the marine type. It is generally necessary to serve in a marine engineering shop. If you have influence or "know somebody" you may get taken on the "shore gang" of a small line and acquire the special experience of marine work in the docks; but you must be a capable fitter and erector, and have served your time for a start. The more you know of the theory of steam in its production and use the easier you will understand what you have to learn. Get Read's "Marine Engineer's Handbook," 12s. 6d. It contains information and instruction on every possible point. "Hints to Sea-going Engineers," about 2s. 6d., gives a good notion of the life you would lead.—T. J. B.

MILLING MACHINE WHEELS.—Can any reader give me the number of wheels that should accompany a milling machine, and the number of teeth both in the smallest and largest wheels; also whether they rise by two teeth or four?—TOOLS.—*A.*—If "Tools" refers to a dividing engine such as is used for gear cutting, he should have wheels increasing by 5 teeth each wheel from 20 to 120 teeth, one of each wheel, with an extra 60 or 90 wheel, also a 58, 63, and 69. With these wheels no doubt he would be able to do all that he requires, as these will divide almost in any required number (except *prime numbers*), as 61, 67, 71, 73, 79, etc. If "Tools" will state what he wants clearly, giving the tangent wheel of the machine, and also say whether it has a single or double worm, I might be able to help him further. As to the number of change wheels which should accompany a milling machine, various makers differ. I have worked them with 24 wheels, as herein mentioned. Some supply 32, 34, 55, 58, and 62 wheels with the machines. Some supply a printed list with the machines, showing what wheels to use for different divisions; others leave the purchasers to find out for themselves. Seeing the extensive use of dividing and milling machines in the workshops of to-day, a small handbook giving a varied list of change wheels for different machines would be acceptable, along with other matter on making milling cutters, etc. There are two small handbooks, one written by J. Broadley, the other by E. Holden, but these do not give a very great variety of tables on the subject. In numerous cases I have had to work out lists for the men to work by. I paste them on a board and varnish them over.—J. H. PI KIN TON.

STRESS IN FRAM-WORK.—Will any reader kindly show me how to obtain the stresses in the following diagram:—



—STATICS.—*A.*—The stresses are all deducible from the diagram itself, the triangle A B D furnishing the triangle of forces. Therefore, first find length of B D relatively to A B = 1. $A B^2 + A D^2 = D B^2 = 1 + 2^2 = 5$ $\sqrt{5} = 2{\cdot}2361 = D B$. The lever A C turns on fulcrum A, and A C = 3 A B. ∴ stress vertically downwards at B = 15 × 3 = 45 tons. Let A D = 45 tons to scale, then $B D = \frac{2{\cdot}23}{2} \times 45 = 50{\cdot}17$ tons = stress on strut B D. A B to scale = $\frac{45}{2}$ tons = horizontal pull on A B, which must be added to the stress in the upper flange of A B due to bending stress. This represents also the horizontal pull on the pin or other fastening at A. Resolving 50·17 tons along B D at the point D in the directions A D and D E, we get A D = 45 tons, and A B = $\frac{45}{2}$ tons representing them. Again, at A, A C being a lever turning about B as a fulcrum, and B C being 2 A B, the vertical stress: on A D = 15 × 2 = 30 tons tension. 45 tons (at D) − 30 tons (at A) gives 15 tons, the pressure taken by the floor at D, which, of course, is equal to the weight at C.—T. J. B.

FRICTION.—Could any reader tell me the difference of friction between a roller with journals of cast iron 15in. diameter working in a half bush 18in. long, and a roller with journals of steel 9in. diameter, working in a half bush 18in. long, each roller to be 30 tons.—BUSH.—*A.*—You do not give number of revolutions. For purposes of calculation I assume 50 revolutions per minute: then for the cast-iron journals the horse power absorbed in friction is (about):—

$$\frac{15 \times 3{\cdot}14 \times 50 \times 30 \times 2240 \times 0{\cdot}049}{12 \times 33{,}000} = 19{\cdot}58 \text{H.P.}$$

For the steel journal:—

$$\frac{9 \times 3{\cdot}14 \times 50 \times 30 \times 2240 \times 0{\cdot}05}{12 \times 33{,}000} = 11{\cdot}17 \text{H.P.}$$

∴ Difference of friction = 19·58 − 11·17 = 8·41 H.P.—T. J. B.—*A.*—You do not give sufficient particulars to give a satisfactory answer to your question. Nothing is said as to the material the bush is to be made of—whether cast iron or gun metal—or the speed at which the shaft will run. We will assume the bush to be gun metal. The pressures on the bearings per square inch of projected surface will be respectively—for cast-iron shaft $\frac{30 \times 2240}{2 \times 15 \times 18} = 124{\cdot}4$lb. per square inch, and for steel shaft $\frac{30 \times 2240}{2 \times 9 \times 18}$, from which it will be seen that the pressures are not excessive and the bearings should be easily lubricated. As to the friction of the bearings, it may be assumed that the coefficient of friction will be about the same for cast iron and steel on brass. With steel the friction will be rather less; but we may assume for them both a value = 0·05. The work done on the bearings in one revolution of the shaft in inch-lb. = W. Then W = L × π d × 0·05. The work done in ft.-lbs. per minute will = P.

$$P = L \times \frac{\pi}{12} d \times R \times 0{\cdot}05.$$

Where L = load on bearings in lb., π = 3·1416, d = diameter of shaft in inches. R = number of revolutions per minute. In the example given we have for cast-iron journal W = 30 × 2240 × 47·12 × 0·05 = 157,920 inch-lb.

For steel—

W = 30 × 2240 × 28·27 × 0·05 = 94,752 inch-lb.

Or $\frac{94{,}752}{157{,}920} = 60$ per cent. more work for the cast-iron journal, showing that the friction is directly as the diameter of the journals. It is therefore advisable where the friction is of importance to reduce the diameter of the journal as much as possible consistent with strength, and lengthen the bearing to increase the surface for wear, and to give a low-bearing pressure.—G. A.

TRIPLE-EXPANSION ENGINE CYLINDERS.—Will any reader show me how to find the diameters of the H.P. and M.P. cylinders, from the following data:—Diameter of L.P. cylinder, 88in.; stroke, 5ft.; revolutions, 73; boiler pressure, 180lb.; 4500 I.H.P.; cut-off in H.P. cylinder, 0·6 stroke.—W. G.—*A.*—To answer your question accurately and completely would occupy a great deal of space, and an approximate result can only be given in this column. In dealing with such questions it is usual to settle first the total ratio of expansion to be adopted, which will depend on the boiler pressure, and then find the mean effective pressure referred to the low-pressure cylinder, and then from the piston speed and the power required find the diameter of the L.P. cylinder. The diameter of the other cylinders will depend on circumstances. The ratio of cylinder volumes adopted in marine practice differs from that of stationary engine practice. In the former case generally the full power of the engine is exerted continuously during long runs, and it is advisable to have a larger ratio of cylinder volumes than with stationary Corliss engines, where the cut-off is automatically regulated by the governor to suit the varying loads. In the latter case the loads and temperature ranges vary throughout the cylinder with the cut off in the H.P. cylinder. With engines having a practically uniform load, as is the case in most marine engines, an equality of stresses and temperature throughout the cylinders is desirable in a general way. To find the mean effective pressure referred to L.P. cylinder, we may proceed, as shown in "The Mechanical World Pocket Book" for 1893, as follows:—The total ratio of expansion for the pressure given will be $\frac{195}{15} = 13$—say 12, to allow for clearance, etc. We have then

$$\frac{195 - 5}{12}\left\{(1 + 2{\cdot}484) - 4\right\} \times 0{\cdot}7 = \frac{190}{12}\left\{(3{\cdot}484) - 4\right\} \times 0{\cdot}7$$

= 35·7lb., say 35lb. mean pressure referred to L.P. cylr. Then area of L.P. cylr. required will be $= \frac{1500 \times 33{,}000}{35 \times 730} = 5812 = 86$in. diameter, showing that a rather less diameter would do the work. The usual ratio of cylinder volumes for the pressure given is about 7·5 to 1; but in order to equalise the work done in the cylinders as much as possible with the late cut-off in the H.P. cylinder given, the ratio of cylinder volsumes should be 7½ or 7 to 1. Taking the latter value, the diameter of the H.P. cylinder will be $\frac{6082}{7} = 869$, or 33½in. diameter—say 33in. diameter. The diameter of the intermediate cylinder is very often made a mean proportional between the two others, in which case the ratio would be 2·64 to 1. We will, however, adopt a ratio of 2·45 for H.P. to I.M.P., and 2·86 for I.M.P. to L.P. We will have then for diameter of I.M.P. cylinder $\frac{6082}{2{\cdot}8} = 2126 =$ say 52in. The diameter of the cylinders will therefore be:—H.P. = 33in., I.M.P. = 52in., and L.P. = 88in. The actual mean effective referred to the L.P. cylinder required to give the power named will be $\frac{4500 \times 33{,}000}{6082 \times 730} = 33$lb. fully. If the power is to be equally divided between each cylinder—*i.e.*, develop 1500 in each,—the mean effective pressure required in the L.P cylinder will be $\frac{33}{3} = 11$lb. In the intermediate cylinder it will = 11 × 2·86 = 31½lb, and in the H.P. cylinder = 11 × 7 = 77lb. These results, of course, take no account of the effect of clearance and receiver passages in each cylinders. The valve would have to be set to cut-off at such points as would give the above mean effective pressures in the respective cylinders. To obtain accurate results the theoretical diagram ought to be drawn, and due allowance made for the points alluded to.—G. A.—The cut-off in H.P. cylinder, as well as diameter of L.P. cylinder, steam pressure, and revolutions, all being given there is only one solution as to horse-power, and that is not the one you require. Suppose terminal pressure in L.P. cylinder is taken at 7lb. *absolute*, then the number of expansions in the series is $\frac{180 \times 15}{7} = 27{\cdot}8$. ∴ the volume of steam in 0·6 of the capacity of the H.P.C. must be $\frac{1}{27{\cdot}8}$ of the total capacity of the L.C.P. (since that amount of steam at initial pressure in H.P.C. has ultimately to fill the whole of the L.P.C. Thus, volume of 0·6 of the H.P.C. $= \frac{6082 \times 60}{27{\cdot}8} = 13{,}232$ cub. in.

∴ Area of H.P. piston $= \frac{13{,}232}{0{\cdot}6 \times 60} = 367{\cdot}5$ sq. in.

∴ Dia. = 21½in. Terminal pressure in H.P.C. and initial pressure in M.P.C. = 195lb. × 0.6 = 117lb. absolute. Mean pressure in H.P.C. $= P_1 \times \frac{1 + \text{hyperbolic log. } r}{r}$ where P_1 = absolute initial pressure, r = ratio of expansion in cylinder in question. Here, = 195 × $\frac{1 + 0{\cdot}70{,}682}{1{\cdot}66} = 176{\cdot}86$lb. = mean pressure in H.P.C.

Effective mean pressure = 176·8 − 117 = 59·8lb., assuming no "drop" between cylinders. The remaining expansion to be effected $= \frac{117}{7} = 16{\cdot}71$. Dividing this equally between the next two cylinders, we get $\sqrt{16{\cdot}71} = 4{\cdot}08$ as the expansion in each of the cylinders.

∴ Cut-off in M.P.C. $= \frac{1}{4{\cdot}08} = 0{\cdot}24$ stroke.

Volume of steam at exhaust in H.P.C. = 367·28 × 60 = 22,036·8 cubic in. This, therefore, = 0·24 volume of M.P.C. ∴ $\frac{22{,}037}{0{\cdot}24 \times 60}$ = 1532 sq. in. = area of piston M.P.C. Diameter M.P.C. ∴ = 44½ inches. Terminal pressure in M.P.C. and initial pressure in L.P.C. (again assuming no "drop") = 117 × 0·24 = 28·08lb. Mean pressure = 117 × $\frac{1 + 1{\cdot}4031}{4{\cdot}08}$ = 69·03lb.

Effective mean pressure = 69·03 − 28·08 = 40·95lb. Recalculating cut-off in L.P.C. to allow for cumulative error in the calculation:—

$$\text{Cut-off} = \frac{\text{Contents of M.P.C. at exhaust}}{\text{Area of L.P. piston}}$$

$$= \frac{1532 \times 60 \text{cub. in.}}{6082} = 15{\cdot}11\text{in.}$$

representing a cut-off of $\frac{15{\cdot}11}{60} = 0{\cdot}25$.

∴ Terminal pressure = 28·08 × 0·25 = 7·021lb.

Mean pressure = $28{\cdot}08 \times \frac{1 + 1{\cdot}3863}{4} = 16{\cdot}75$lb.

Effective mean pressure = 16·75 − 4 = 12·75lb. (assuming 4lb. as the allowable back pressure in L.P.C.) Now for the horse-power. Horse-power of H.P.C. $= \frac{367{\cdot}5 \times 59{\cdot}8 \times 730}{33{,}000} = \frac{\text{I.H.P.}}{486{\cdot}14}$

Horse-power of

$$\text{M.P.C.} = \frac{1532 \times 40{\cdot}9 \times 730}{33{,}000} = 1386{\cdot}10$$

Horse-power of

$$\text{L.P.C.} = \frac{6082 \times 12{\cdot}75 \times 730}{33{,}000} = \frac{1715{\cdot}10}{3537{\cdot}64}$$

This is the total theoretical horse-power of the arrangement. To get the horse-power required you must increase your revolutions, and to get a more even turning moment, if you are using three cranks, as well as a lower proportion of initial to mean pressure, you must increase the size of your H.P. and M.P. cylinders, and give an earlier cut-off in H.P. cylinder. The "Royal Oak" battleship has cylinders 40in., 59in., and 88in. diameter, 4ft. 3in. stroke, 150lb. steam, 4500 H.P., with natural draught.—T. J. B.

Latest Inventions.

APPLICATIONS FOR LETTERS PATENT.

When Patents have been "communicated," the name of the communicating party is printed in italics.

Where complete specification accompanies application, an asterisk is suffixed.

28th November, 1892.

21,657 FURNACES of STEAM BOILERS. J J Cunliffe and W Fielding

21,658 HYDRAULIC SAFETY VALVE. W Stone.

21,663 SEPARATION and REMOVAL of OILS and GASES from the FEED-WATER of STEAM ENGINES. J Peacock.

21,664 APPLIANCE to be USED as a TUBE CUTTER. H G Bell.

21,667 FRICTION CLUTCHES. T G Rhodes and others.

21,668 RAILWAY CHAIRS and FASTENINGS. J Grant.

21,669 VALVES. D Thomas.

21,671 OBTAINING MOTIVE POWER from the PRESSURE of the WAVES. C Barnett.

21,672 FIREPLACES or FURNACES USED by BLACKSMITHS and WHITESMITHS. W Hayhurst and Son.

21,674 EXPANDING CUTTER TOOLS for BORING and MILLING. H Noble and P Lund.

21,676 AUTOMATIC VARIABLE EXPANSION GEAR for STEAM ENGINES. J M Austin.

21,681 SAFETY GUARD and OBSTRUCTION REMOVER for TRAMWAY ENGINES and CARS. J Pogson.

21,682 FRICTION CLUTCH. The Bull Dog Friction Clutch Syndicate Ltd. and W Ambler.

21,690 REVOLUTION COUNTERS. O A Berend.

21,693 ELECTRICAL METER and RECORDER. P Feys and J Lorwa.

21,696 ELECTRIC SMELTING of ALUMINOUS and OTHER REFRACTORY ORES or COMPOUNDS. T L Willson.

21,698 ROCK DRILLS.* S G McKiernan.

21,701 REDUCTION or TREATMENT of REFRACTORY METALLIC COMPOUNDS by ELECTRIC SMELTING. T L Willson.

21,706 COMPOUND ENGINES. R H Fowler and W Daniel.

21,717 PACKINGS for STEAM-GAUGE GLASS, GLANDS, and TUBES.* T P Kerman.

21,722 VALVES for REGULATING the ENTRANCE of WATER to or DISCHARGE from TANKS. J V Glover and W D Stevens.

29th November, 1892.

21,737 MOTIVE-POWER ENGINES ACTUATED by STEAM or GAS. H Lindley and others.

21,741 JOINTING of PIPES and OTHER TUBULAR CONDUITS. R F Drury. (*B Powel*, Australia.)

21,742 METALLIC PACKING for PISTON RODS. S A Ward.

21,743 RAILWAY CHAIR IMPROVEMENTS. H H Perry and T O Jacobsen.
21,748 TUYERE for RIVET FORGES. T Maughan.
21,749 TOOL for CUTTING OVAL, CONICAL, or PARALLEL HOLES THROUGH IRON or STEEL PLATES. J and H Greenhalgh.
21,752 SELF-GENERATING GAS or VAPOUR BURNERS. J Johnstone.
21,755 WATER-TUBE STEAM GENERATORS. J Johnson. (*J Pierpoint*, United States.)
21,761 PROCESSES of REDUCING ORES.* A J Rossi and others.
21,762 APPARATUS for SIGNALLING UPON RAILWAYS. J Walker.
21,764 STAMPED or FORGED RAILWAY AXLE BOXES.* C C Longridge and J D Twinberrow.
21,768 PACKING for PISTON RODS. T Keene.
21,777 PLATES for STEAM BOILERS, ETC. R Baird.
21,782 ELECTRICAL RESISTANCE COILS. Siemens Bros. and Co. Ltd. and J Nebel.
21,789 BARGES for CARRYING OIL. M Samuel and J F Flannery.
21,790 WOOD TUBES. E Lüdke.
21,799 MULTIPLE-CYLINDER ENGINES.* E B Benham.
21,800 MECHANISM for ACTUATING PUNKAHS and THERMANTIDOTES. H Heatly.
21,802 LIFTING JACK. W Tully.
21,803 ELECTRIC TRANSFORMERS. C E L Brown.
21,808 FURNACES for STEAM BOILERS.* W P Thompson. (*F Barclay*, United States.)
21,811 MULTIPHASE ALTERNATING-CURRENT MOTORS WITHOUT SEPARATE EXCITATION. C E L Brown.
21,812 PNEUMATIC TOOLS.* J G Carlinet and others.
21,820 CIRCULAR SAWS. R Elsdon.
21,823 MOTOR. J K Foord.
21,826 TREATMENT of ORES CONTAINING ZINC and ANTIMONY. H L Sulman.
21,828 MANUFACTURE of PIG IRON from IRON ORE. W H D'A Cleminson.
21,830 USE of ELECTRICITY in MINES. C W Atkinson and the Electrical Coal-cutting Contract Corporation Limited.

30th November, 1892.

21,838 AXLE BEARINGS. J T Halliday and R Clark.
21,841 GAS and OIL ENGINES. J E Weyman and others.
21,855 MACHINE for BENDING or SETTING PLATES REQUIRED for SHIPS. H O Bennie.
21,856 STEAM ENGINES. W H Scott.
21,857 FEEDING OIL ENGINES with OIL in DULY-REGULATED MANNER.* H Winckler. (*C Jastram*, Germany.)
21,858 REVERSING GEAR.* H Winckler. (*C Jastram*, Germany.)
21,866 STEAM GENERATORS. T D Walker and P Duff.
21,867 OIL SEPARATOR. I S McDougall.
21,868 TOOTH GEARING. B S Roberts.
21,871 APPARATUS EMPLOYED in the MANUFACTURE of ILLUMINATING and HEATING GAS.* H Fourness.
21,874 ELECTRIC LIGHT and OTHER PENDANTS. H L T Lyon.
21,883 WOOD-WORKING MACHINE. F R Lee.
21,884 COUPLINGS for RAILWAY VEHICLES. J N Braun.
21,890 WOOD-TURNING LATHES. E Kemp.
21,892 RAILROADS. E T Hughes. (*W Latimer*, United States.)
21,893 PROPELLERS. J L Adams and E H Watrous.
21,901 AUTOMATIC BRAKES. L A Parrock and A T O Hawkins.
21,903 METAL DIES. The Phœnix Metal Die and Engineering Company Limited and R M Murdoch.
21,905 INDICATING at ONE STATION TEMPERATURES or ATMOSPHERIC PRESSURES EXISTING at VARIOUS PLACES.* J Bartlett.
21,906 ELECTRIC ALARM of DANGER from FIRE or WATER. A Liedcke and P Jacobi.
21,909 ENGINE GLANDS. J Bradley.
21,914 ARTIFICIAL FUEL.* H Pazolt.
21,917 APPARATUS for IGNITING the COMBUSTIBLE CHARGES or GAS MIXTURES of GAS and OIL ENGINES. J Wetter. (*J Rademacher*, Germany.)
21,918 TUBULAR FEED-WATER HEATERS. W H Sankey.
21,919 MAKING ELECTRICAL CONNECTIONS and DISPOSITION of CIRCUITS CARRYING INDUCED CURRENTS. C Olivetti.
21,922 GRINDING or CRUSHING MILLS. H C Higginson.
21,924 DRIVING GEAR for TRACTION ENGINES. W D Fowler and C F Christopher.
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FRIDAY, DECEMBER 23RD, 1892.

The Galloway Engine for the Chicago Exhibition.

THE engine to be used for driving the machinery in the British section of the Chicago Exhibition is, we understand, being supplied by Messrs. Galloways Limited, of Manchester. It is of the horizontal superposed compound condensing type, and is to indicate 350H.P. at 70 revolutions per minute with 100lb boiler pressure. The high-pressure cylinder is 17in., and the low-pressure 30in. diameter, both having a stroke of 3ft. 9in. There are several special features about this engine which it may be interesting to notice. It is to be fitted with Messrs. Galloway's latest gear, and with other improvements they have recently introduced. The distribution of steam is effected by means of short slide valves, the high-pressure cylinder being provided with a multiple-ported or gridiron expansion valve, working on the back of the main slide. The expansion valve is to be operated by means of a curved slotted link, in connection with an improved expansion motion patented by Messrs. Galloway in 1890, allowing the admission of steam at full pressure, without the intervention of a throttle valve, and with a quick cut-off at any point from 0 to 66 per cent. of the stroke of the piston. The governor, which is to be driven by gearing, is of their improved "Parabolic" type, for obtaining great sensibility and steadiness of turning, and is to be connected directly to the rod of the expansion slide valve. The crank necks will be 12in. diameter, and with regard to the fly-wheel—which is 23ft. diameter, grooved for twelve 1¼in. ropes—a special arrangement is necessary, owing to the peculiar position in which the engine will be placed. As the position of the second main shaft will only allow of a small-size pulley being placed upon it, and as the speed of this shaft is not yet determined upon, Messrs. Galloway have been compelled to lengthen the main shaft of the engine, which will be supported upon an extra bearing and carry a supplementary fly-wheel for straps, and of a size to be determined by the requirements of the Exhibition authorities. The main fly-wheel of the engine will consequently be entirely useless at the Exhibition, but it will show how the engine would be built for driving an ordinary mill.

Proposed Paris-Brussels Electric Railway.

A MILE a minute is rather a high speed for railway travelling, but this rate has not yet been attained between Paris and Brussels. It is, however, proposed—indeed, it was projected some months ago—to accomplish this by means of electric locomotives, and only last week a Brussels paper gave currency to a statement to that effect. It mentioned, on the one hand, that the North Belgian Company had not lost sight of the scheme, and that it had already commenced renewing the permanent way with heavier rails. On the other hand, it stated that delay had not taken place in undertaking experiments with an electric locomotive, which would allow travellers to journey from Charleroi to Paris in 2hr. 50min., and from Brussels to Paris in 3hr. 20min. The distance between the two latter cities is about 192 miles. A train would be composed of locomotive, four carriages and two vans. No details are of course given, and, with such a scheme, we are not surprised at this. The project is perfectly feasible, but we are afraid that the announcement is not only premature but also greatly exaggerated. The cost of equipping such a line and of erecting the several generating stations which would be necessary, would, we imagine, be far beyond the capabilities of the two railway companies concerned; whilst at the same time it is doubtful whether, in the light of present electric railway practice, anyone would be disposed to make such a large experiment. The truth of the matter may probably be found in tests with electric traction proposed to be made on a Brussels local line.

Launch of H.M.S. "Niger."

ON Saturday last the Naval Construction and Armaments Company launched from their shipbuilding yard, at Barrow-in-Furness, the third of the six torpedo gunboats building by contract under the Naval Defence Act of 1888. Her dimensions are:—Length between perpendiculars, 230ft.; breadth, extreme, 27ft.; depth, moulded, 14ft. 3in., with displacement of 810 tons at 8ft. 9½in. load draft. The vessel is propelled by twin screws, with two sets of triple-expansion vertical inverted cylinder engines, capable of developing 3500I.H.P., and driving the vessel at a speed of 20 knots per hour, the diameter of cylinders being 22, 34, and 51in., with 21in. stroke. The boilers are of steel, four in number, 16ft. long by 7ft. 8in. diameter. They are of the locomotive type, and each has two furnaces, the working pressure of steam being 150lb. The armament consists of one 4·7in. quick-firing gun on forecastle head, with a range of fire from right ahead to 40° abaft the beam; one 4·7in. gun aft on upper deck, with a right aft fire to 45° before the beam; two three-pounder guns forward under forecastle and two amidships; also one fixed torpedo forward, and two tubes on racers, amidships, for discharging Whitehead torpedoes.

Engraving on Glass by Electricity.

AN interesting application of electricity in the ornamentation of glass ware has been brought to a practical stage by Dr. A. H. Phelps, of Glens Falls, New York. The tool used consists of a brass tube, lightly packed with shredded asbestos, and through which pass two conductors which terminate in binding posts. From the end of the brass tube projects a pointed piece of slate against which rests a piece of platinum wire, the ends of which are fastened to the binding posts. Through the large tube is a small brass tube, extending to the bottom, and this permits of a flow of cool water which goes through the handle and passes away along another tube. A current of 50 ampères at 5 volts is sent through the platinum wire, which is brought to white incandescence. The pointed slate pencil supports the wire and allows of a moderate pressure being applied to the point without damaging the wire. The object to be engraved upon is held by the operator in one hand and the tool in the other, the article generally being a piece of ornamental copper-flashed glass ware. The film of red-coloured glass upon the outside is so thin that the least scratch will expose clear glass, and all marks thus made upon the surface stand out transparent against a red ground. The principle upon which the method works is as follows:—The heated platinum wire, as it touches the glass, causes the part immediately underneath it to expand and chip off from the body. As the wire is passed over the surface rather quickly, the chips are very minute and present a peculiar appearance under the microscope, being triangular in shape and curved on the surface. Some of the chips, as they fly from the glass, are melted by the incandescent platinum wire, and as the tool is lifted fine fibres of glass are drawn out; these are removed from the work by scraping the surface of the glass with a piece of sheet copper. This method, which is the application of an old device to a new use, attracted some attention at the recent American Institute Fair.

Smokeless Gunpowder.

SOME important trials were last week carried out with smokeless gunpowder at the artillery range of Sir William Armstrong and Co., at Silloth, Cumberland. M. St. Marc, a French military officer, is the inventor of this variety of the new explosive, and the trials at Silloth have been conducted under his personal superintendence. The base of smokeless powders hitherto invented has usually been nitro-glycerine, which begins to "sweat" and becomes dangerous when the temperature goes below the freezing point; and another objection to former inventions of the kind has been that the powder would not keep. M. St. Marc claims that the smokeless powder which he has invented is not open to either of the objections named. His powder has for its base an unchangeable substance procured by the chemical admixture of six ingredients. It is claimed that it heats the gun much less than any other powder yet manufactured. It is also perfectly smokeless, very dense, and burns slowly. In one of the trials at Silloth this powder was tried with a Hotchkiss quick-firing gun, and the most satisfactory of the tests showed that with a charge of 5oz. a projectile weighing 3·3lb. left the muzzle at a velocity of 645yds. per second. From a return published by one authority it seems that with ordinary gunpowder and a Hotchkiss gun of similar calibre to that used in the experiment at Silloth, a projectile weighing 3lb. 8oz. leaves the muzzle at a velocity of 666·2yds. per second, after an expenditure of nearly 1lb. 3oz. of powder.

Employment in the Engineering Trades.

THE condition of employment throughout the engineering industry remains very much the same as reported last month, the returns issued this month by the workmen's organisations showing no appreciable change in the number of out-of-work members on the books. The Amalgamated Society of Engineers is able to report a slight decrease in the number of members receiving out-of-work support; but this is not sufficient to affect the general average, which remains at between 7 and 8 per cent. of the total membership, with the number of unemployed members in this immediate district still in excess of that of the average for the country generally, although the reports are more favourable than they have been recently. The report of the Steam Engine Makers' Society shows practically no change in the condition of employment so far as its members are concerned, the numbers in receipt of donation benefit remaining at about 4½ per cent. of the total membership. With regard to the condition of trade in the various districts covered by the above-named societies, the position is reported to be certainly no worse, but if anything an increased weight of work is stated to have been coming forward in some quarters. In several of the marine centres an improvement is reported, but others still remain only in a very depressed condition. Heavy stationary engine builders are still reported to be fairly off for orders, and some of the machine-tool makers are kept tolerably well employed, but the locomotive building trade is now in a very depressed state.

Telephony.

IT seems that, after all, the New Telephone Company is not a new telephone undertaking. Formed some months ago to establish a cheaper and more efficient telephone service in the metropolis and in the provinces, on the double-wire or metallic return system, the company—or, rather, the directors—now propose to amalgamate with the National Telephone Company and prolong the existing monopoly. When the telephone companies combined in 1889, promises were made similar to those set forth by the New Telephone Company, and now at the end of 1892 we seem to be no nearer their realisation. Perhaps, however, the projected amalgamation will prove beneficial; we trust, if agreed to by the shareholders, that it will, and that telephony will become telephony in the fullest sense of the word.

To What Extent Can the Milling Machine Replace the Planer in Daily Operation? *

IN the present day, when old machinery has served its allotted time of usefulness in the shop and must be replaced by tools replete with modern ideas, it is a matter of no small moment to every practical, progressive shop director having the responsibility of semi-annual dividends thrust upon his shoulders, to determine just what type of machines to select which will be best adapted to his special line of work.

For example, if the work has always been done on planers—and they are peculiarly adapted to it,—would it be advisable to replace the old ones with new ones with latest improvements and added strength? If so, what will be the percentage of gain in time over those now in use? Or shall a milling machine be the tool to be placed on trial to shorten the present hours of work performance? And also, what type? not whose make. In all the written data relating to milling machines and their many good qualities, the writer has been unable to discover anything which would enlighten him in such manner that he could know intelligently and to a certainty which type of machine would be the most desirable for the class of work to be operated upon. It has been found during investigation preparatory to purchase, in answer to the all-important question: How much work will the milling machine perform in a given length of time, and how will that amount compare with the work produced from the planer in the same time? that the builders of machine tools give nothing definite whereby we can base our calculations. They confine themselves generally to the superiority of their manufacture over competitors, which we always concede.

In the example which I shall quote, one manufacturer of both planers and milling machines, who knew from personal observation just what the class of work was, expressed himself favourable to the planer as being the machine best adapted for it. But a decision being made in favour of the milling machine, and the type known as a "slabber" being chosen, it was bought and placed in position in the works, especial attention being given to its foundation, and warning being given to its maker that it would be subjected to the severest duties in its battle for supremacy over its rival the planer, and the true merits of the milling machine demonstrated in comparison, if possible. I would like to add, in parentheses, that I have always thought the builders of this especial machine were a little bit more

* By W. S. Rogers, of Troy, N.Y., read before the American Society of Engineers.

slack about it than they would have been if they had not received our "warnings."

The planer used in this test is of modern build (being about three years old), carries two heads, and is 30 × 30in. × 8ft., having a table travel of 27ft. per minute. The tools used are Mushet's steel, 1½in. square. Both machines are fully equipped with chucks and clamping devices for suitably holding the work, and in charge of first-class mechanics of long experience, and between whom considerable rivalry existed. The favourable results from the milling machine in comparison to the planer are somewhat surprising, even to those who know it best.

Eight pieces of cast iron, 17in. long, having a surface 8in. wide and 1¼in. down each side, to be rough finished, are done on the planer in 4½ hours, the pieces being placed on the platen in two rows, and both heads being used simultaneously. The time required by the milling machine was just 41 minutes, straddle-mill cutters being used and one casting being operated upon at a time, the amount of metal removed being about 1-16in. in both cases.

Another class of work was cast-iron strips 16in. long, ½in. thick, and 1½in. wide, to be rough finished all over. The best time made on the planers was found to be at the rate of four every 36min., while the milling machine turned off six every 6min. The planers in this case were small modern machines, carrying single heads and having a cutting speed of 22ft. per minute. The spindle of the milling machine makes 34 revolutions per minute, while the platen travels 13in. in the same interval. The platen travel per minute has been doubled after coming to the works without affecting the cutter rotation. Another item of importance brought out was the fact that the cutters were colder and held their cutting qualities longer when the speed of the platen was increased and the work forced harder against them, thus conclusively demonstrating, to the writer at least, that it is frictional contact which tends to dull the cutters and wear them away by grinding, and not the actual work performed. Memoranda kept during the past year also indicate the cost for renewals for cutters and grinding to be about 25 per cent. less than the running expenses for planer tools.

Another important practical result brought about by the milling machine after it was in full service was the total abandonment of three planers and one shaper, previously used on this work, all of which now goes to the miller, and an increase in the capacity of production of over 25 per cent., thus at the same time bringing about a greater uniformity of work than could possibly have existed under other conditions, and, lastly, causing a reduction in the pay roll, not from a reduction of wages, but because fewer men were required.

To the writer, these figures from the milling machine are not conclusive nor satisfactory. I think the platen travel of this type of machine can be increased to 20in. per minute under the same conditions for "roughing-off" work and leaving enough for finishing. I speak now only of cast iron; steel and other metals would be slower in proportion. There are to-day a thousand and one varieties of heavy work being done slowly on planers which should be done rapidly on milling machines, but the milling machine must be designed and patterned closely upon the lines of the modern planer, and must universally reach over and around the work on the platen, and be as easy to handle and operate as the present planer is to-day.

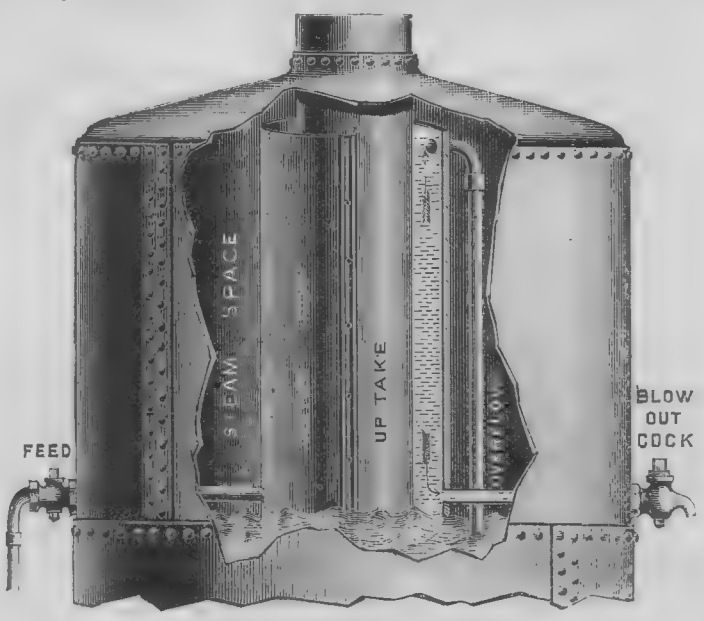
Another thought brought out from close association with a miller is the inconvenience at present existing for clamping and chucking the work. If it requires 20 minutes to clamp a piece on the planer and one hour to plane it, and only requires 20 minutes milling, but one hour is used up in clamping it securely on the miller, the latter becomes an expensive tool, and all the argument is in favour of the planer.

I have said nothing about the overhung-arm type of milling machine in this paper, as it covers a field of its own in competition with small planers, shapers and slotters, doing nice work and reasonably rapid, but as yet not up to what its possibilities are, the reason being chiefly that it is lacking in rigidity and strength in its component parts.

A novel utilisation of aluminium is that for the construction of aluminium slate pencils. Major von Sillich, of Meiningen, has found that aluminium gives a stroke on a slate, and a German company has undertaken the manufacture of pencils based on that fact. They are 5mm. thick and 14mm. long. They need no pointing, and are described as well-nigh inexhaustible and unbreakable. The writing, which is as clear as with ordinary pencils, requires a little more pressure. It can be erased with a wet sponge.

Passman's Boiler Feed-water Heater.

The illustration herewith shows a very simple and inexpensive method of heating the feed water of vertical boilers. As will be seen, a cylindrical water jacket or



Boiler Feed-water Heater.

chamber surrounds the uptake; this is fixed in segments, and the connection with the uptake being made water-tight, a water space of from 2 to 6in. is provided, according to size. Through the shell of the boiler to the bottom of the water chamber is fixed the feed pipe, so that when the boiler is feeding water through the injector or pump, the water enters and rises to the top of the water chamber, completely surrounding the uptake with water. In this way the waste heat in the uptake above the water line is absorbed, and the uptake protected from over-heating. The water rising to the top of the water chamber overflows down a pipe into the water below at a very high temperature. At the opposite side and close to the bottom of the water chamber is fixed a pipe for the purpose of blowing out occasionally the sediment or dirt that may accumulate in the water chamber, and which is easily expelled by the steam in the boiler.

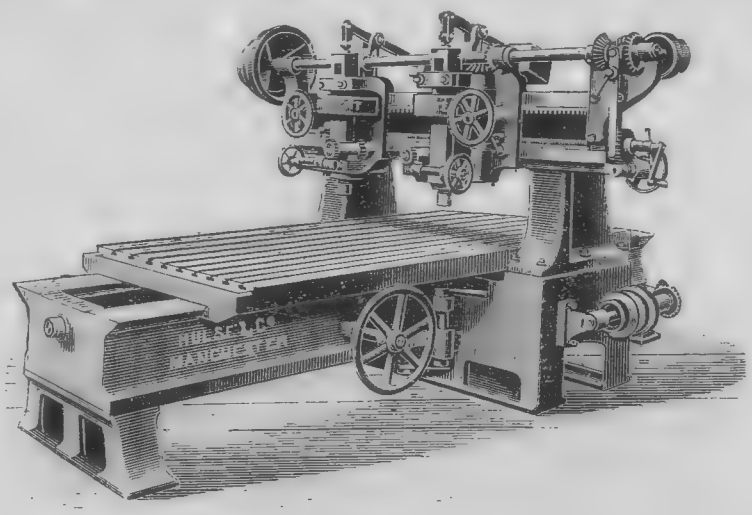
It is claimed that this method of heating the feed, besides promoting economy of fuel, prolongs the life of the boiler, since it thoroughly protects the uptake from over-heating. It is also claimed that the water is purified, and that the boiler does not require to be cleaned out as frequently in consequence. Mr. J. F. Passman, Middlesbrough, the inventor and maker, will furnish additional particulars upon application.

Owing to the slackness of the sheet-iron trade, Messrs. Isaac Jenks and Sons, Beaver Works, Wolverhampton, have temporarily closed their works

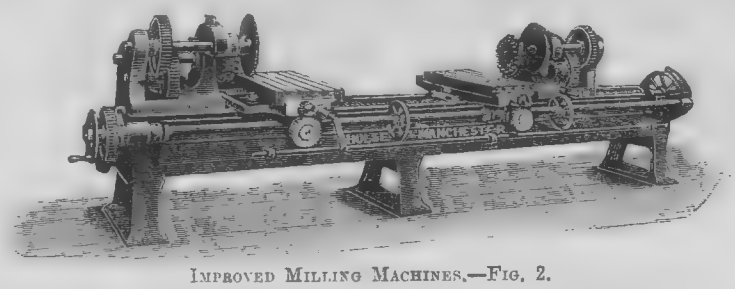
Improved Milling Machines.

It is scarcely possible to overrate the importance of the influence which the use of high-class machine tools has had upon almost every description of textile machinery. We need, therefore, make no apology for introducing to the notice of our readers some machine tools which embody the latest advances made in these appliances, and says "The Textile Manufacturer," calculated to be of the greatest possible service in a machine shop.

Of the two illustrations herewith, Fig. 1 represents a patent two-spindle milling machine, specially designed for machining the faces on the frame sides of looms and other textile machine frames. This tool is capable of accurately machining all the faces on a loom side (that is, one with 8 faces on one side, and 7 on the other) in about an hour and a half, these faces having areas ranging from about 9sq. in. to 21sq. in. The machine consists of a strong slide bed surmounted by a table with tee grooves (planed out of the solid), having variable self-acting feed motions in both directions. It has also quick-power traverse motions, the latter being so arranged that after two faces have been machined the spaces intervening between them and the next may be rapidly passed over. Above the table, and at right angles with it, is placed a compound cross slide with an upright next each end, firmly bolted to the bed. This cross slide carries two horizontal slides, each fitted with a counterbalanced vertical spindle slide of square section, carrying inside a steel spindle with hard gun-metal conical bearings, and a hardened steel adjustable tail pin for resisting the upward pressure due to the "cut." Arrangements are made for imparting to the horizontal slides independent and variable self-acting feed motions in both directions along the cross slide, and the vertical spindle slides have adjustable stops and quick withdrawal motions, so that where facings in recesses or surrounded by beadings have to be operated upon, the "face" cutters may be rapidly withdrawn from the work, and at once advanced again to the same plane horizontally with absolute accuracy. The cutter spindles are rotated by machine-cut spur gearing, the pinions being long and keyed firmly to their shafts to avoid the freedom and consequent unsteadiness that would arise if short pinions and sliding keys were employed, and a four-speed cone-driving pulley at the end of the cross slide affords the requisite variations in speed for the different diameters of cutters used.



Improved Milling Machines.—Fig. 1.



Improved Milling Machines.—Fig. 2.

The illustration is taken from a machine with a table 10ft. long, intended chiefly for dealing with long frame slides. The lengths of tables usually employed for dealing with the majority of loom slides vary from 4ft. 6in. to 5ft. 6in., the widths being from 4ft. to 4ft. 6in. These dimensions may, however, be modified to suit special requirements.

The machine shown in Fig. 2 works in conjunction with the vertical milling machine just described, and is for facing the ends of cross-rails or stays which connect the frame sides together. It consists of a slide bed mounted upon standards, having at the left-hand end a double-geared fast headstock, and at the right a double-geared movable headstock, while between them are two transverse slides with tee-grooved tables, to which a number of objects to be faced simultaneously at both ends are secured. The movable headstock and the table nearest to it may be traversed along the bed for various lengths of work by means of a central guide screw and rotating worm nuts, by which latter fine adjustments may be effected. Each headstock carries a built-up facing cutter of large diameter, and has, in addition, a circular saw for cutting off mule beams approximately to length prior to their passing between the facing cutters, which finally reduce them to the dead length required. These saws can, if desired, be omitted. A longitudinal steel driving shaft passes within the bed from end to end for giving rotation to the headstock spindles. The latter are of steel, and provided with conical bearings and end adjustments. The shaft is driven by fast and loose pulleys situated at the right-hand end of the bed.

Variable self-acting feed motions transversely are provided for the tables, arranged so that either table may be "fed" separately or both simultaneously. They may be engaged or disengaged by the attendant from the working position, and traversed quickly in either transverse direction, while the machine may be set in motion or stopped at any part along the front of the bed. The tables each measure 34in. by 16in., and objects 9in. in depth and up to 8ft. in length, or longer if desired, may be operated upon. Further particulars of these useful tools may be had from the makers, Messrs. Hulse and Co., Ordsal Works, Salford, Manchester.

Hull and District Institution of Engineers and Naval Architects.

The usual monthly meeting of the members of the above institution was held on Monday evening, the 12th inst., at the Institute Rooms, Bond-street, the president, Mr. J. Spear, being in the chair.

After the formal business had been gone through, Mr. F. H. Street was called upon to read his promised paper on "The Benefit of Thorough Ventilation of Ships, etc."

After defining "good" ventilation as a means of changing the air or atmosphere in any enclosed space without causing draughts, the lecturer pointed out how entirely the medical professors of the present day differed from those of 50 years ago. Then, pure air was not thought necessary to either "health" or "comfort." Now, say the doctors, to enjoy good health you must have pure fresh air, and plenty of it. Proceeding, Mr. Street enumerated several of the means in vogue at the present day in the ventilation of ships, churches, etc., etc., and explained how much superior the "compressed-air system" was over the majority of the others, especially in the easy manner in which it is controlled and the entire absence of draughts. Many other interesting and useful details were given during the evening.

The paper was illustrated by drawings and models and an exceedingly interesting table giving the volume of air necessary per hour for each human being or animal in different spaces, the table being compiled from actual experiments made at all hours of the day and night, and under all

sorts of conditions—in hospitals, theatres, schools, dwelling-houses, prisons, workshops, barracks, stables, ships, etc., etc.

The following gentlemen took part in the discussion which followed:—Messrs F. H. Pearson, J. Spear, H. Shoesmith, A. H. Tyacke, J. B. Hutchinson, P. Frith, W. G. Gibbons, M. Stirling, and M. Houlder.

On the motion of Mr. Stirling, seconded by Mr. Pearson, a hearty vote of thanks was accorded Mr. Street for his paper, which was duly acknowledged.

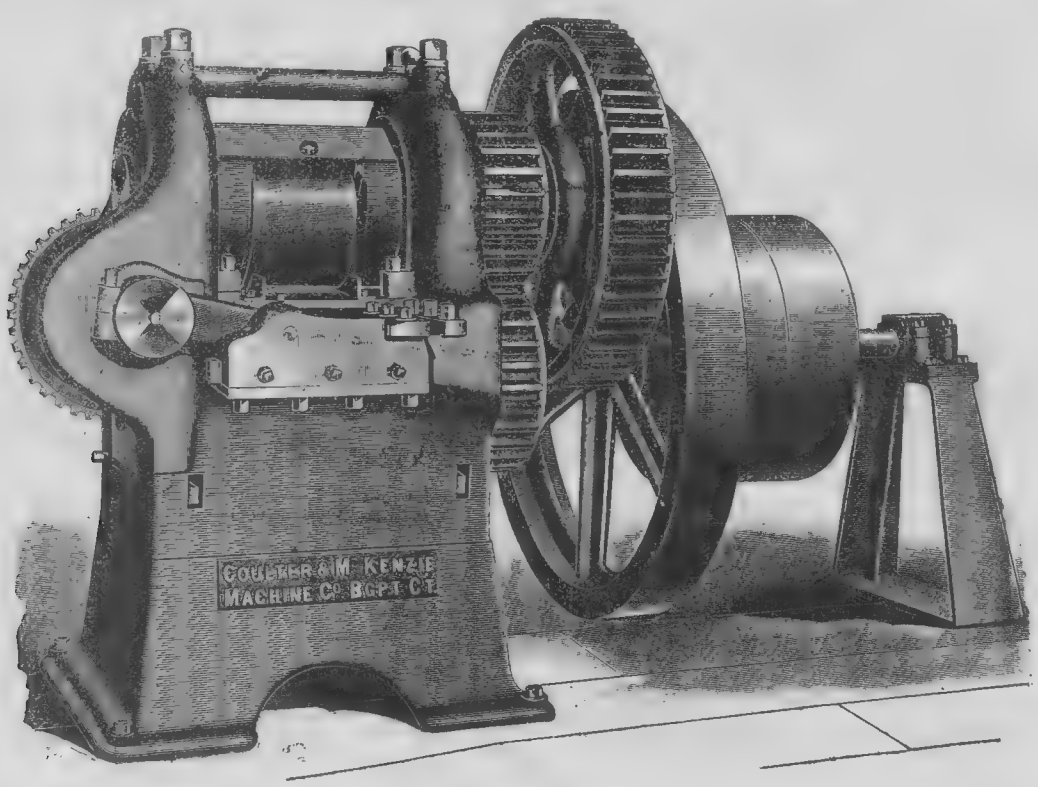
Taper Rolling Machine.

THE Coulter and McKenzie Machine Company, of Bridgeport, Conn., U.S.A., have designed a machine for rolling flat tapers on round, square, and flat bars of steel of large section. Small pieces, such as wagon springs, files, edge tools, etc., are usually tapered under the hammer or with grooved rolls. In the latter case several roll dies are necessary, and an increase in the first cost and cost of repair is the result.

The machine illustrated is fitted with plain flat dies, which work in combination with a squeezing or edging arrangement. The work comes from the machine smooth, with no fin or flash on the edge, and with no sign of the objectionable "cold shuts." With the same dies the machine may be adjusted to taper 6in. × ½in. flats, and all sizes of rounds, flats, and squares under these dimensions.

The lower roll is adjustable vertically to accommodate the different thicknesses of materials used, up to 1in., and is operated by means of large taper keys placed beneath the roll, to correspond with tapered recesses planed into the lower boxes, thus ensuring parallel bearings. If more than 1in. adjustment is desired thinner dies are used. The rolls are cut away to receive the dies, which are simply plain chilled castings set in and held by keys, and made adjustable with steel set screws in order to produce any taper required.

The bar to be tapered is passed in between the roll dies (just before they come into operative position) and pressed forward until it comes in contact with one of several adjustable stops, where the dies grip the bar and return it to the starting point, at the same time rolling the taper. Each stop is set further back than the preceding one, so as to increase the length of taper, the principle being the same whether the bar is passed once or several times, the number of passes being governed by the amount of stock to be reduced.



TAPER ROLLING MACHINE.

After being passed between the rolls the bar is squeezed sideways and shaped as desired by means of a fixed die or a series of dies placed one above the other in the form of steps, the width and shape of these dies varying to produce any required width and shape of taper, all of which is arranged on a slide, which moves upon a plate forming part of the machine, this squeezer mechanism being driven by a pair of bevel wheels from the main back shaft, and is timed with the rolls. The work, says the "Iron Age," is performed quietly, is free from scale or hammer marks, and all ends are tapered alike; therefore, where grinding is necessary, the finishing is considerably reduced.

The rolls are 14in. in diameter, 18in. between housings, and are geared four to one; the sides or housings are 7in. thick. The balance wheel is 4ft. 9in. in diameter, 7in. face, 3½in. thick, driven by tight and loose pulleys 30 × 8, the usual speed being about 80 revolutions. The floor space required is 6ft. × 8ft., height 5ft. 6in., and weight about 7 tons.

This machine is now in practical use at Pencoyd, Pa., Johnstown, Pa., and other points. In some places it produces a taper of 16in. and under, on 1⅛in. round, at the rate of 4000 points a day.

A New Revolution Counter.

WE present with this, engravings showing the general appearance and construction of a new revolution counter which has some novel features—among these the ability to count revolutions at much higher speeds than usual.

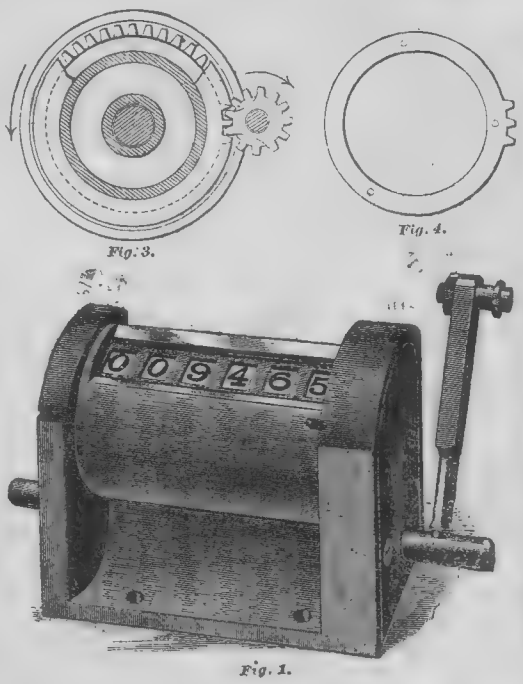


Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

NEW REVOLUTION COUNTER.

The counting wheels are placed loosely upon a shaft which passes from end to end through the counter, these wheels and the pinions by which they are moved being enclosed within a cylinder, which can be turned to any one of three different positions in the frame, so that the reading point may be on top, as shown in the perspective cut, or it may be at either side, as is most convenient, and the change from one to the other is made by simply removing and inserting one screw.

Fig. 2 gives a sectional view of the counter, showing the lever and pawl by which the first wheel is moved. The short lever *e* is upon a shaft (shown in section which passes through and projects at both sides of the machine, so that it may be connected and operated at either side. The lever *e* works within the opening in the pawl H, which is so formed that it moves the ratchet wheel one tooth at each oscillation, and prevents it from being moved is held still by the blank portion of the wheel entering one of the three openings in the pinion, this being an application of the principle of the Geneva stop motion. One-third of a revolution of the pinion moves the next counting wheel one-tenth of a revolution.

All the wheels are alike, and are connected by pinions which are alike, the result being that each succeeding wheel is turned one-tenth of a revolution by a complete revolution of the wheel to the right of it. With six wheels 1,000,000 are counted, and the figures are placed close together, making it easy to read and distinct more than one tooth, so that this movement is positive. It makes no difference, says the "American Machinist," whether the shaft and lever *e* be rotated continuously or given an oscillating motion with the lever above or below the shaft; the counting goes on the same — one revolution or one oscillation advancing the first wheel one figure. Motion is transmitted from this first wheel to the second by means of the small pinion seen at the right of Figs. 3 and 5. This pinion, though made of a single piece of steel, is in reality in two parts, one of which is an interrupted pinion which is arranged to be turned one-third of a revolution by the engagement of the three teeth seen on the wheel, Fig. 4, which is riveted to the left of each counting wheel. During the rest of the revolution of the wheel, Fig. 4, the pinion to tamper with. The lever *e*, the pawl H, the ratchet wheel, and all the gears and pinions, are made of steel, the pawl ratchet and lever hardened, so that it may be expected to be durable and reliable in action.

As to capacity to count at comparatively high speeds, it is only necessary to say that a representative of this journal timed one of them which was run by holding the shaft in a drill chuck and driving it in a speed lathe. It counted at the rate of 2000 revolutions per minute, and ran continuously, without apparent effort, at 1500 revolutions. It is made in two sizes, and, where desired, is furnished with a set-back attachment, which, by the movement of a lever, sets all the wheels at zero. The manufacturers are the Davids Machine Works, 129, Worth-street, New York City, U.S.A.

Machine Construction.

THE CONSTRUCTION OF MACHINE ELEMENTS.

(*Continued from page* 224.)

§ 147.

DETERMINATION OF THE ANGLE OF TORSION.

IN a cylindrical shaft of a diameter *d*, which transmits a statical moment P R, throughout its length L, the modulus of torsion of the material being G, we have from No I., § 14, the angle of torsion.

$$\theta^\circ = \frac{P R L}{J p G} = \frac{S L}{G a}$$

$$\theta^\circ = \frac{32 \times 360\ P R \times 12\ L}{2\pi\ d^4\ G} = \frac{360\ S\ 12\ L}{\pi G d} \quad ..(136)$$

which for wrought iron, in which G = 11,386,000, gives

$$\theta^\circ = 0{\cdot}00062\ \frac{P R\ L}{d^4} = 0{\cdot}0001218\ S\ \frac{L}{d} \quad ..(137)$$

For cast iron these values are doubled, giving

$$\theta^\circ = 0{\cdot}00124\ \frac{P R L}{d^4} = 0\ 0002436\ S\ \frac{L}{d} \quad ..(138)$$

Here L is taken in feet and S is the stress at the point of application on the shaft. It will be noticed that the angle θ can be determined very readily when S is known. It must be remembered that *d* and S are closely related, and that the value of *d* depends upon the value taken for S.

Various applications of twisting moments may be reduced to a single one for use in the formulas, by classification under some one of the following heads, taking the value for L as follows (see § 13, § 14):—

(*a*) L = the whole length of the shaft, in feet, when the force is applied at one end and transmitted to the other,

(*b*) L = half the length of the shaft when the twisting forces are applied over the entire length uniformly.

(*c*) L = one-third the length of the shaft when the twisting forces diminish uniformly from one end to the other of the shaft, as in § 14, case III.

(*d*) In general, the distance of the point of application of a collected number of twisting forces distributed in any manner along the length of the shaft, may be found by multiplying the power applied at each point (in horse-power), by its distance from the end of the shaft, adding the several products together and dividing by the total horse-power transmitted.

The methods may be illustrated by the same examples which were given in the preceding section.

Example 1.—The screw propeller shaft given in the previous Example 1, gives the following data: S = 8200lb., *d* = 15in., L = 72ft.

According to (137) we have

$$\theta = 0{\cdot}0001218\ \frac{8200 \times 72}{15} = 4{\cdot}75^\circ.$$

This will be reduced to ⅞ this value, or 3½° when either of the cranks is on the dead centre.

Example 2.—The line of shafting given in Example 3 of the preceding section is made of two diameters in the bearings and in the body, and these must be combined. The bearings may be taken at 4in. long each, and are 32 in number. We have then

$$\theta = 0\ 0001208 \left[\left(\frac{32 \times 0 \times 33 \times 7397}{3{\cdot}875} \right) \div \left(\frac{(223 - 10)6541}{4} \right) \right]$$

$$= 0{\cdot}000120\text{8}\ (50158 - 34\text{8}310) = 44\tfrac{1}{2}\text{in.}$$

a deflection which must be very marked, with variable loads, and entirely inadmissible with fine machinery.

Example 3.—If the preceding shaft had been made 5in. diameter, as by Fairbairn's formula, we have for N = 1·2[illegible].

$$\theta = \frac{0{\cdot}550 \times 1{\cdot}263 \times 223}{8^4} = 2{\cdot}67^\circ.$$

Example 4.—A shaft 16½ft. long, and of a constant diameter, transmits 70H.P. at 100 revolutions. The power is taken off by a number of machines, ranged at uniform distances apart. According to the table for $\frac{N}{n} = 0{\cdot}7$, the diameter should be 4in. In determining the

torsion, the value of L is taken at one-half the length of the line (case *b*), giving:—

$$\theta^{\circ} = 0{\cdot}00082\ \frac{625{\cdot}0 \times 0{\cdot}7 \times 82}{(4\frac{1}{2})^4} = \text{about } 6\tfrac{3}{4}^{\circ}.$$

Since the formula is based on an angular deflection of 0·75° per ft., we might have obtained direct, 82×0·75=6·35°, or nearly the same value.

If in any case the calculated deflection appears too great, the diameter of the shaft must be increased, and since the denominator of the equation is the fourth power of the shaft diameter, a slight increase in its value effects a marked reduction in the deflection.

Example 5.—If the angle in the preceding example is desired to be reduced to one-half its value, the diameter must be multiplied by $\sqrt[4]{2}$ or by 1·189, hence $d = 4{\cdot}25 \times 1{\cdot}189 = 5$in.

§ 148.

JOURNALS FOR SHAFTING.—ROUND ROLLED SHAFTING.

The journals on shafting are either end journals, and treated as already shown, or, as in most cases, necked journals, and the length of bearing made as given in § 92. For line shafting, the special determination of journals is unnecessary. Unless there is some apparent reason for a special determination of the journals (as in the case of locomotives), the journal length *l* is usually taken quite large, as $\frac{3}{2}d$, $2d$, $4d$. (see § 109 *et seq.*), care being taken to ensure proper support of the journals in the hangers.

The Kirkstall Forge Company, of Leeds, have produced shafting which is rolled round and requires no turning. The round finish is given by the action of plane discs, whose geometric axes are horizontal and parallel, about 8in apart, and revolve rapidly. (See § 195.) The discs are placed so as to act upon the bar as it leaves the rolls, and are cooled with water, and their action produces a true cylindrical form to the shafting, and gives it a highly finished surface, so that it is at once ready for use without being turned in a lathe. By this process the modulus of resistance is also increased nearly 20 per cent. over that of shafting rolled in the ordinary manner, as shown by tests by Kirkaldy, and given in the catalogue of the Kirkstall Forge Company, for the Melbourne Exposition. This feature is not of as much importance as at first appears, although it is of some value.

The absence of turning is also of advantage, and the increasing use of this shafting is doubtless due to both causes. The principal objection to it lies in the fact that the hard outer skin cannot be disturbed without affecting the truth of its form. Keyways cut in it invariably cause springing.

Some of the modern methods of securing pulleys without cutting keyways may be used to avoid this difficulty. The journals and wheel seats on this kind of shafting do not require turning.

(*To be continued.*)

Shipbuilding Notes.

In response to an invitation of the United States Navy Department, tenders have been deposited for the construction of a new battleship of 9000 tons and an armoured cruiser of 8000 tons. The lowest tender in each case was received from Messrs. Cramps, of Philadelphia, who offer to build the battleship for 3,110,000dols., and the cruiser for 3,086,000dols.

On the 12th inst. the s.s. "Andrassy," a steel screw steamer, built by Messrs. Wigham Richardson and Co., at their Neptune Works, Newcastle-on-Tyne, had a very successful trial trip off the Tyne. She is 240ft. in length by 34ft. beam, and is fitted with triple-expansion engines, which, with the boilers, have been constructed by Messrs. Wigham Richardson and Co. During the trial trip the machinery worked without the slightest hitch, driving the vessel at a good speed and giving complete satisfaction to all present.

The Belfast shipbuilding trade this year has continued brisk, although since November the employés in all the yards have been on short time. The vessels built by Messrs. Harland and Wolff had a gross tonnage of 68,612, against 64,962 last year—an increase of 3650 tons. The total tonnage of Messrs. Workman, Clark and Co. is 19,215 tons, against 24,922 tons last year—a decrease of 5707. Great delay was caused by a fire in this yard. Messrs. Macilwaine and Maccoll have built an aggregate tonnage of 5173 tons.

On the 17th inst. there was launched from the yard of Messrs. S. P. Austin and Son, Wear Dockyard, Sunderland, a steel screw steamer of the following dimensions:—Length, 225ft.; breadth, 33ft. 3in.; depth, 16ft. 11in.; tonnage, gross 1160 tons, net 720 tons. She will be fitted with triple-expansion engines. She is the last vessel which will be constructed on this berth, as Messrs. Austin are reconstructing their yard, with the view of building a larger type of steamer than was before possible.

The Design and Construction of Stationary Engines.—XLIII.

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TABLE XXVII.—DIMENSIONS OF CROSS-HEAD AND CRANK PINS.

Diameter of Pin in in.	Crank Pin. Brass. $l=1{\cdot}25d$. P	N≦	Crank Pin. White Metal. $l=1{\cdot}35d$. P	N≦	Cross-head Pin. $l=2d$. P
2	5,192	204	4,796	236	8,581
2¼	6,270	185	5,808	215	10,384
2⅜	7,458	169	6,908	197	12,364
2 7/16	8,756	155	8,118	181	14,498
2½	10,164	145	9,416	167	16,808
3	11,660	135	10,868	157	19,294
3 1/16	13,266	127	12,584	147	21,956
3⅛	14,982	119	13 882	139	24,794
3 3/16	16,786	113	15,554	131	27,808
3¼	19,140	107	17,336	124	30,976
3 5/16	20,716	102	19,206	118	34,320
4⅜	22,858	97	21,586	112	37,840
4⅜	25,030	93	23,116	107	41,536
4½	27,434	89	25,410	102	45,364
4⅝	29,876	85	27,676	98	49,412
4 11/16	32,406	82	30,030	94	53,614
5⅛	35,046	78	32,472	91	57,992
5⅛	40,6 6	73	37,664	84	67,276
5 13/16	46,662	68	43,230	79	77,220
6¼	53.806	64	49,192	74	87.868
6 1/16	59,796	60	55,528	70	99,176
7 1/16	67,188	57	62 260	66	111,188
7½	74,866	54	69,366	62	123,904
7¼	82,940	51	76,868	59	137,500
8¼	91,354	48	84,744	56	—
8 3/16	100,364	46	93,016	54	—
9	109,692	44	101,662	51	—
9 1/16	119,438	42	110,682	49	—

P=load in lb. N=No. of revolutions pe minute. *l*=length of bearing. *d*=diameter of pin in inches.

Table XXVII. gives the diameters of crank and crosshead pins, with suitable loads for different lengths, and for brass and white metal bearings, with maximum revolutions, representing Continental practice. The loads there given appear to be rather high. Table XXVIII. gives a number of particulars of crank pins and crank necks for various types of engines, collated from actual practice, which may be found useful for purposes of comparison.

Other particulars as to sizes of pins will be given later in a table of wrought-iron cranks.

(*To be continued.*)

TABLE XXVIII.—DIMENSIONS OF CRANK PINS AND NECKS.

Type of Engine.	Arrangement of Cylinders.	Arrangement of Cranks.	Boiler Pressure.	No. of Revs. per Minute.	I.H.P.	Crank Pin. Diam. In.	Crank Pin. L'ngth. In.	Crankshaft Necks. Diam. In.	Crankshaft Necks. L'ngth. In.	Cylinder. Diam. In.	Cylinder. Stroke. In.
Horiz. single non-con.	—	—	60	49	—	2¼	3	4	6	10	24
,,	—	—	70	40	—	2⅜	3½	5	7½	12	36
,,	—	—	100	30	—	3⅜	4½	6	12	14	30
,,	—	—	70	40	—	3	3½	5½	8	14	36
,,	—	—	75	36	—	4	5	7	10	19	42
,,	—	—	70	36	—	4	5	7½	10	18	42
,,	—	—	70	35	—	4	5	8	12	20	48
,,	—	—	75	35	—	5	5½	9	14	24	48
,,	—	—	70	40	—	5	6	10	16	28	54
,,	—	—	70	40	—	6	6	10½	16	30	48
Horiz. single con.	—	—	70	65	—	3	4	5½	8	12	36
,,	—	—	70	75	—	3	4	5½	8	14	36
,,	—	—	90	60	100	3½	4½	5½	10	14½	38
,,	—	—	70	58	—	3¾	5	7½	11	18	36
,,	—	—	80	60	—	4½	5	8½ / 9	14 / 15½	20	48
,,	—	—	80	60	—	4¾	6	8½	14	22	48
Single C'rliss con.	Vertical	—	80	70	—	5½	6½	9 / 10	18 / 20	24	36
Horiz. single con.	—	—	80	60	200	5	6½	9 / 10	16 / 17	25	48
,,	—	—	80	70	—	5½	7	9½	18	28	48
Single C'rliss con.	—	—	85	68	340	6	9	11	20	30	60
Horiz. single con.	—	—	80	50	340	5½	7	10 / 11	16 / 18	30	60
,,	—	—	80	50	600	10	11	14 / 16	26 / 30	38	72
Horiz. C'rliss comp. con.	Tandem	—	100	75	300	6	7	9 / 10	18 / 18	16 / 30	48
Horiz. comp. con.	Pair tandem	Right angles	85	57	1120	7	9	15	28	24 / 42	60
,,	,,	,,	100	52	1400	8	10½	16	32	24 / 46	72
,,	,,	,,	120	55	1440	9	11	16	32	26 / 48	60
,,	,,	,,	90	50	1400	10	11	17	34	26 / 46	72
,,	,,	,,	98	50½	1194	12	10½	16 / 17½	30 / 32	28 / 52	72
,,	,,	,,	90	52	1700	9½	11	18	37	30 / 50	72
Ver. comp.	Side by side	Right angles	120	71	720	7	8	12	24	23 / 46	54
Horiz. comp. con.	Side by side	Right angles	100	49	203	5	6	9½	14½	16 / 30	60
,,	,,	,,	—	50	1000	7	10	13½	27	22 / 42	72
,,	,,	,,	90	60	700	7	9	12	24	24 / 45	60
,,	,,	,,	100	50	900	7	9	15	28	26 / 48	72
,,	,,	,,	70	50	—	8	9	15	28	26 / 48	72
,,	,,	,,	110	44	1800	10	11	18	36	35 / 60	84
,,	,,	,,	100	49·1	2000	12	11	20	36	42 / 72	72
,,	,,	,,	95	50	2000	12	12	19	38	38 / 66	72
Horiz. comp. con.	Pair tandem	Right angles	80	50	1000	7	9	15½	28	24 / 42	60
,,	—	—	90	45	1600	8½	10	16	30	32 / 52	72

State of the Skilled Labour Market.

THE following memorandum has been prepared for the "Board of Trade Journal" by the Labour Correspondent of the Board of Trade:—

During the past month the condition of the skilled labour market has remained tolerably steady. Indeed in a few trades there has been some improvement, and but for the increasing dulness of the shipbuilding industry as orders are completed, and the stoppage of so many mills in the South-east Lancashire spinning districts, a general improvement might have been recorded. In shipbuilding districts the pattern-making, iron-founding, and other engineering branches are very depressed, but the engineering trade at large holds up remarkably well, and the figures sent in are slightly better than those of a month ago. The clothing trades are much depressed, and in the boot and shoe branch work is scarce; many men are entirely unemployed, and a considerable number are only working short time. The building and cabinet-making trades show remarkable steadiness, and the percentage of unemployed in each is, for the season, very small. There has also been a marked revival in the printing industry, but this trade is so much subject to seasonable influences that this improvement has little general significance. The gloomiest feature in the industrial situation is the deadlock in the cotton trade, which gives no indication of an early termination. The strikes of the month have not been numerous, nor, with the exception of that above referred to, have they been of great importance. In all 44 have been noted; of these eight were in the building trades, seven in the coal trade, four in shipbuilding, five in textiles, two in clothing trades, and the remainder in other industries.

In all 22 trade unions have sent in returns as to the state of their respective labour markets. These reports show an aggregate membership of 270,288, of which 22,342 are out of work, as against 19,684 in the previous month. The percentage is thus 8·27, as against 7·33 in the previous month. In this, however, is included upwards of 2000 of the cotton operatives engaged in dispute, so that but for this the change upon the figures of the previous month would have been very slight indeed. For the corresponding month of last year the percentage of those out of work was 3·81, and for the corresponding month in 1890, 2·40.

Two unions generally report that their trade is "very bad," eleven say it is "bad," six say it is "moderate," while but three report it as "good."

Trade Notes.

The John Cockerill Company, Liege, Belgium, has received a large order for steel rails from the Roumanian Government.

Messrs. Firmstone and Brothers, Stourbridge, have contracted to supply 100 tons of 4in. cast-iron pipes to the Exeter Corporation.

Messrs. O. L. Kummer and Co., of Dresden, have obtained the contract for the electric lighting of the quays at Magdeburg, Germany.

Messrs. Manlove, Alliott and Co. Limited, Nottingham, have received an order from the Warrington Town Council for a patent steam disinfector.

The Stockton Malleable Iron Company, Stockton, are supplying the steel required for the Watkin Tower, now in course of erection at Wembley Park.

Messrs. R. Laidlaw and Son, Glasgow, have secured an order from the Paisley Water Commissioners to supply 257 tons of cast-iron pipes of various sizes.

Messrs. William Adam and Co., Glasgow, have contracted with several of the railway companies to supply their Lucigen light for the purpose of lighting up goods and shunting yards.

Messrs. J. and R. Houston, Cartsburn Foundry, Greenock, have secured a large contract to supply all the machinery and iron work for another new sugar refinery in Australia.

The contract for the erection of the electric signals in connection with the Clifton Rocks Railway has been secured by Messrs King, Mendham and Co., Western Electrical Works, Bristol and London.

The Wilson and Bailey Manufacturing Company, of South Brooklyn, N.Y., have been awarded the contract for the foundation work in connection with the extension of the Brooklyn elevated railways.

The Steel Railway Journal-box Company have taken a portion of the site formerly occupied by Messrs. Barningham and Co., Pendleton Ironworks, Manchester. They intend erecting works for the manufacture of stamped axle boxes.

Messrs. John Davis and Son, All Saints Works, Derby, have been awarded two gold, three silver, and one bronze medal, at the Kimberley Exhibition, South Africa, for their exhibits of electric-light fittings, incandescent electric-lighting safety lamps, and engineering instruments.

Messrs. Brown Bros., Rosebank Ironworks, Edinburgh, have completed the steering gear for the Cunarder "Campania." It is the largest gear ever made, weighing no less than 35 tons. The same firm have also on hand the hydraulic cargo working gear for the two Royal Mail Packet steamers building at Clydebank and Dumbarton.

Readers of "The Mechanical World" are invited to send to the publisher of "Good Health," the new weekly paper devoted to food, drink, medicine and sanitation, for a parcel of specimen copies, which will be sent gratis and post free, for distribution among their friends at home and abroad. Address, 391, Strand, London, or New Bridge-street, Manchester.

Wheel cutter in metal only. Every description of gearing. R. CHIDLAW, 43, City-road, Manchester.

Having regard to the enormous circulation of THE MECHANICAL WORLD, the Editor suggests that it is by far the best medium for the insertion of every kind of "Wanted" advertisement, and the price is only one halfpenny per word. The Editor will be glad if MECHANICAL WORLD readers will kindly bear this in mind as occasion arises.

SMITHFIELD CLUB SHOW, 1892.

THE ninety-fifth annual show of the Smithfield Club, which was held at the Agricultural Hall, London, from the 5th to the 9th inst., was fully up to the average of the immediately preceding years. About the same number of firms exhibited machinery and implements as last year, but several of these complained of the small amount of space available, whereby they were prevented from exhibiting many of their specialities. It is becoming increasingly evident that the building no longer offers adequate facilities for the exhibitors, and the absence of many well-known firms may in part be thus explained. A careful inspection of the various stands revealed no very striking novelties in steam engines, but it is not difficult to account for this at least, to some extent. We must not forget that, apart from the stress of a busy year, it is all but impossible to improve most of the standard types of agricultural engines, *except in points of detail;* and at the present show there was no lack of alterations in the minor parts of many of the engines, that were quickly detected by the experienced engineer. Then, again, we must remember also that many of the firms represented are constantly introducing new machinery for special purposes, which is not suitable for exhibition. Of the variety and extent of this outside work, the photographs on the stands gave a very good idea. We may here remark that in getting out a new design, wisdom is shown by adhering pretty closely to the lines of present practice; there is, then, plenty of scope for showing ability in the form and proportions of the details.

A few years ago there was every indication of the compound principle being speedily adopted for ploughing, traction, and portable engines; but this transformation evidently is not likely to take place yet. This year, for instance, there were only *three* firms which had compound traction engines at the show, while there was not *one compound portable* engine that we noticed. The traction engines were two of Messrs. Burrell's well-known "Woolf" cylinder type, and Messrs. Fowler and Foden had each a side-by-side intermediate receiver type of compound. Are we to infer from this fact that the compound traction engine is not realising the advantages claimed for it? We know that some makers who are in a position to supply compound traction engines are rarely asked for them; but this teaches us nothing respecting the economy of the compound engine, the simple engine being often preferred because of its simplicity and low cost. As regards the economy of the compound traction engine, we may refer to Mr. Foden's two engines at the Newcastle Show, where the compound traction gave 29 per cent. better results than the single-cylinder engine; but it will be remembered that the compound engine was fitted with special valve gear, and the boiler was worked at the enormously high pressure of 250lb. per square inch. But we are now dealing with commercial traction engines, both simple and compound, working at the same pressure—viz., 140lb. In regular practice we fear that nothing like an economy of 25 per cent. is realised by compounding. Moreover, the opinions of the traction-engine makers are divided on this subject. Messrs. Fowler and Co. have, for good reasons, advocated compound traction and ploughing engines for many years, while Messrs. Aveling and Porter doubtless have equally good reasons for mostly rejecting them. The latter firm are in a position (like other makers) to supply compound road locomotive mounted on springs in their usual and successful method. Mr. Foden has modified his spring arrangement, and is able with confidence to recommend it to his customers. We have illustrated both these plans. There is one more spring arrangement which must not be overlooked, and that is shown by Messrs. Wallis and Steevens. The question might well be asked, Why should Messrs. Burrell, Fowler, M'Laren, and Foden bestow so much time and ingenuity on their spring systems, if Messrs. Wallis's simpler plan will answer the same purpose? In a successful spring-mounted traction engine provision must be made for the up-and-down movement of the axle on both sides, so that the gearing is not affected by these movements. The axle may be thrown out of level by various causes, yet a perfect spring engine will allow all sorts of movements to take place, and *yet the gearing will be maintained in pitch.* Now Messrs. Wallis and Steevens simply allow the axle to slide up and down, and the main gearing must take its chance, the teeth being thrown deeper in, or farther out of gear, with every movement of the axle.

We were somewhat struck with the advantages claimed for this plan of spring arrangement as set forth by the makers in their catalogue, which we quote, as the extract will serve as a study of catalogue literature:—

"Where traction engines are used almost exclusively for hauling, and are constantly travelling on rough or stony roads, it has been found of great advantage that some spring arrangement should be applied to take off part of the vibration, both to assist the engine in steady running and preventing wear caused by the vibration, as also on account of the comfort of the drivers. By the use of our spring arrangement a driver can with comfort remain twice as long on his engine as on one without springs; this consequently enabling the engine to be kept longer in work, thereby effecting a saving both in money and the comfort of the men. The blessing of this invention to the engine drivers can hardly be over-estimated. Our arrangement is very simple, but most efficient. The spring motion is taken on the main axle, which is only allowed to be actuated about ⅜in. This gives a perfect result. The springs in no way affect the power of the engine (as, in our opinion, results if the wheels are made to spring, as with some makers). The simplicity is absolute, and by the turning of a screw the spring can in a minute be put out of action altogether, leaving the engine as an ordinary one."

We offer no opinion on this spring arrangement, but leave the matter for traction-engine experts to think about.

Lack of space will not allow more to be said about other traction engines on view, but we must not omit to notice the general workmanship. We noticed a marked absence of all rough finish that once characterised much of the machinery in the galleries, and some downstairs also. Some of the abominable specimens of wretched workmanship have disappeared that once

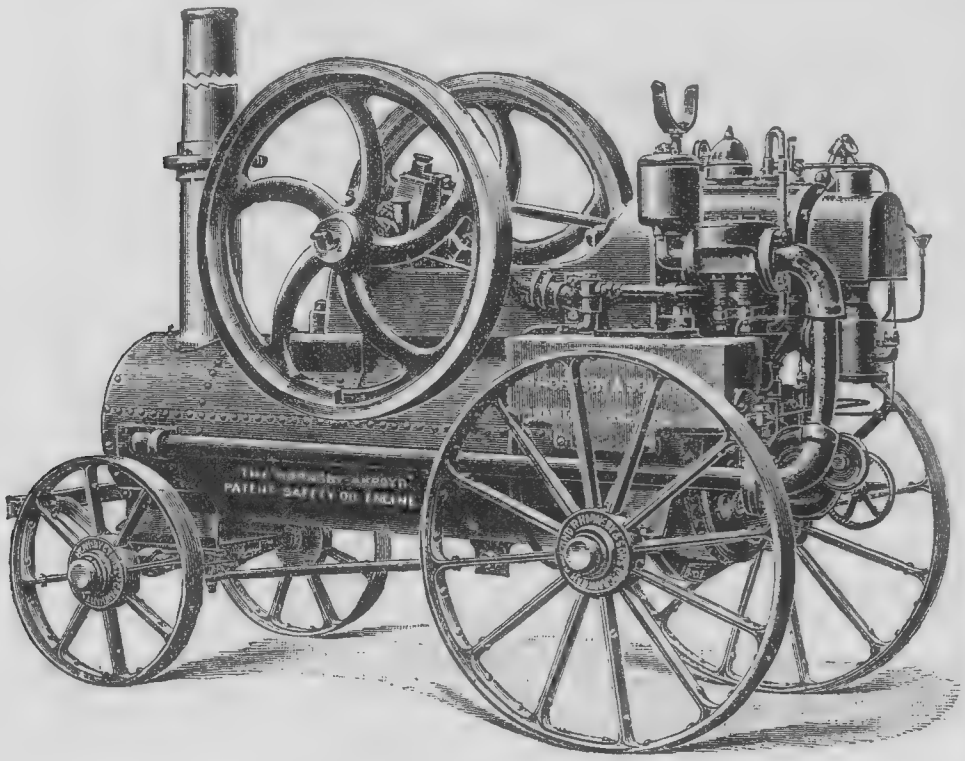

FIG. 1.—THE HORNSBY-AKROYD PORTABLE OIL ENGINE.

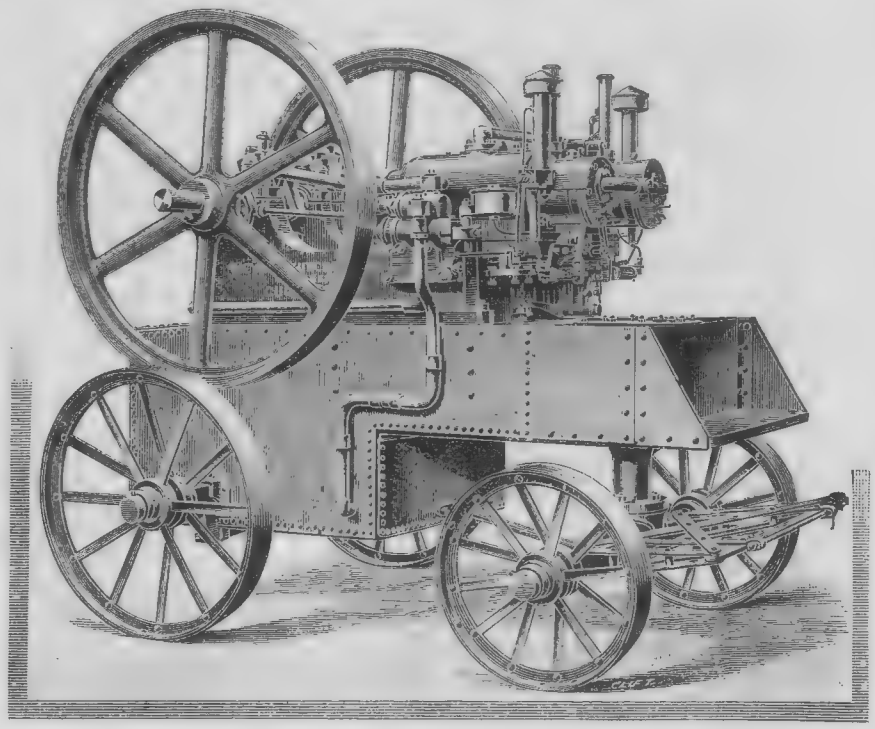

FIG. 2.—"THE TRUSTY" PORTABLE OIL ENGINE.

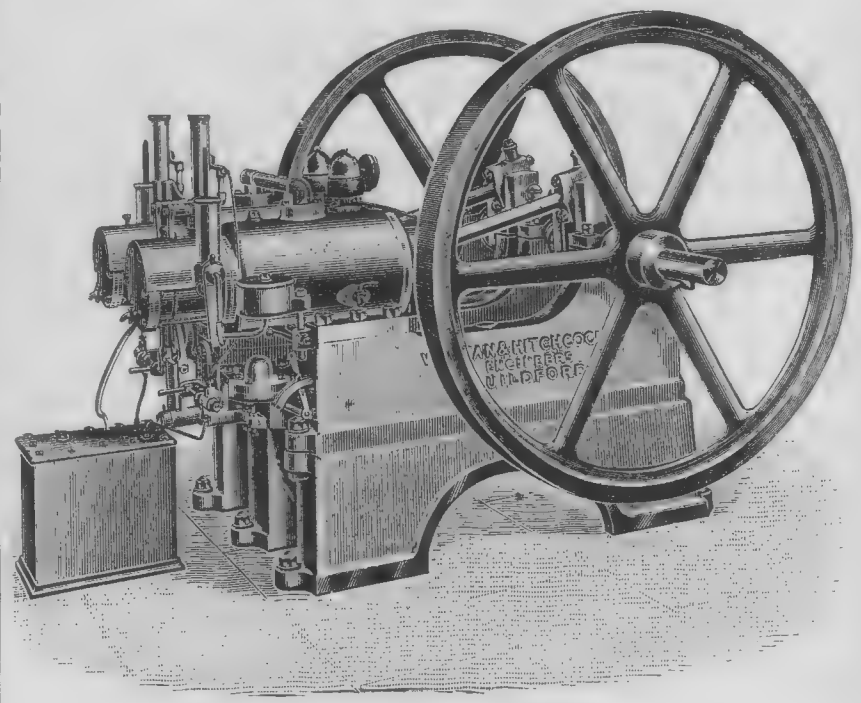

FIG. 3.—4½B.H.P. "TRUSTY" OIL ENGINE.

graced the space in the galleries, where red lead, lamp cotton, gilded lagging bands, and stained woodwork kept company on the same article. It is noticeable that the small firms this year clearly show a great improvement in their workmanship, but we are afraid some of the large firms do not show much advance in this respect.

Good finish is of further importance, inasmuch that most engine drivers will take a pride in keeping an engine in good order and clean, if it be nicely painted; and by experience we know that bright work and good varnish yield an influence for good. When an engine is faulty as regards design and workmanship, no amount of paint and polished work will make it look well. But when an engine is creditably designed, it is poor policy to scamp the finish.

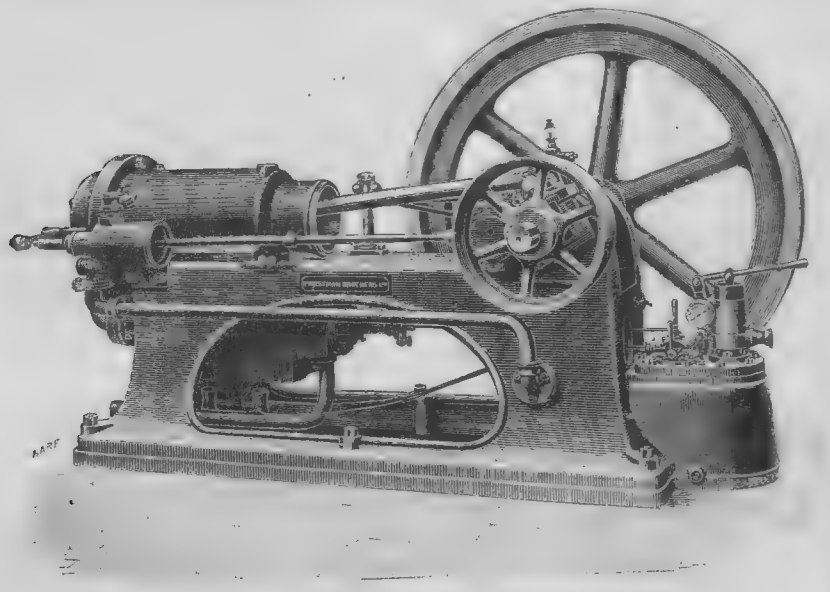

FIG. 4.—THE PRIESTMAN OIL ENGINE.

A word must be given to the ploughs, potato diggers, etc., of American manufacture which were on view. Many visitors were struck with the charming transfers of landscapes and flowers that adorned these goods; but we noticed and admired the details, which were beautifully made. The clean forgings and castings were cheaply and properly put together, the parts were nicely formed, and light where weight could be dispensed with. The varnish used was like enamel. We certainly have something to learn from our American cousins yet.

OIL AND GAS ENGINES.

Strange to say, the exhibits of oil and gas engines, of which a large number are usually to be found at this and similar shows, were by no means large.

Messrs. R. HORNSBY AND SONS LIMITED exhibited two forms of the now well-known Hornsby-Akroyd oil engine—one of the stationary and one of the portable type, the latter being shown in Fig. 1. The makers claim that this engine will use oil of a heavier (and therefore of a cheaper and safer) description than any other oil engine on the market. It is easily started, a lamp being used to heat the external vapouriser with the aid of a small rotary fan. After the engine has been started (which operation occupies from three to five minutes) the lamp is extinguished, the heat required in the vapouriser to cause continuous explosion being furnished by the ordinary explosions of the engine. As will be seen from the illustration, the exhaust pipe is carried alongside the engine, and enters what would be the smoke-box in a steam portable engine. The end of the pipe is turned up near the base of the chimney, and acting somewhat similar to a locomotive blast pipe it creates a strong draught of air through the tubes running from end to end of the water vessel, greatly assisting in lowering the temperature of the jacket water, and thereby reducing the amount used. The cost of running is placed at ½d. per brake horse-power per hour.

Messrs. WEYMAN AND HITCHCOCK LIMITED exhibited a new double-cylinder portable "Trusty" oil engine, which is shown in Fig. 2. The engine is styled a 23I.H.P. motor, and will give 16 actual or brake horse-power. Recently on trial, this engine drove a 4ft. 6in. thrashing machine, which was fed as rapidly and continuously as possible, upon a consumption of 9 pints of oil per hour. As will be seen, the usual practice of arranging the engine similar to an ordinary portable engine has in this instance been departed from. The makers' reasons for adopting the rectangular form of tank is that the round boiler-shaped water tank gives the least water space with the greatest height and over-all dimensions, with the worst shape for fixing the engine and other parts to. It is, of course, often possible to dispense with the water tank altogether, and to draw the water for cooling the cylinder by the circulating pump from a stream, pond, or tub placed near the engine. Both cylinders of this engine are operated by one shaft; if desired one of the cylinders may be thrown out of operation altogether, when the engine can be used as a single-cylinder motor. The advantage of this arrangement is very great, more especially as it involves no alteration beyond the adjustment of a small controlling lever. In addition to the portable, the makers exhibited a 4½B.H.P. (Fig. 3), and also a 1B.H.P. engine. These were all well-finished engines.

Messrs. PRIESTMAN BROTHERS LIMITED, of Hull, exhibited one of their most recent forms of oil engine, which is shown in Fig. 4. As will be seen, some modification has been made in the bed of the engine, which has now a much lighter appearance than formerly. Messrs. Priestman Brothers are also manufacturers of the Priestman dredger, excavator and elevator, working models of which were shown at the same stand. We understand that upwards of 600 of these machines have been supplied and are at work in different parts of the world.

Messrs. J. M. GROB AND CO. exhibited the "Capitaine" oil engine, which has already been fully described in these columns.

Messrs. TANGYES LIMITED had on view one of their 8½B.H.P. gas engines, combined with a 5in. geared three-throw vertical ram pump of 6in. stroke. This pump is intended to raise 6000gals. of water per hour to a vertical height of 120ft. We may here note that at the present time Messrs. Tangyes have orders in progress for seven gas engines each, to indicate 100H.P. in a single cylinder. Four of them are to be worked in conjunction with Dowson gas plant.

STEAM ENGINES AND IMPLEMENTS.

Messrs. RUSTON, PROCTOR AND CO. LIMITED, Lincoln, exhibited the 8H.P. portable engine shown in Fig. 5. This engine has evidently been carefully designed, and the workmanship bestowed upon it leaves nothing to be desired. All the supports are riveted to the boiler and planed to receive the engine, with two pedestals to the crankshaft. The engine parts being all erected upon the riveted brackets, no bolts pass into the steam space, consequently any part of the engine can be taken off the boiler while steam is up. They also exhibited an 8H.P. traction engine, a Class U vertical engine for electric lighting, and a well-finished horizontal engine with automatic-expansion gear. The cylinder of the latter, which is 9in. in diameter and 16in. stroke, is steam-jacketed, and a special ejector is fitted to the jacket to keep it clear of water. This firm also showed a 4ft. 6in. finishing thrashing machine of 6H.P., with a drum 22in. in diameter, and fitted with eccentric motion, etc.

Messrs. JOHN FOWLER AND CO. LIMITED, Leeds, exhibited a 12H.P. compound ploughing engine; also a single-cylinder traction engine, fitted with water lifter, winding-forward drum, and rope. The cylinder is steam-jacketed and the speed controlled by a very sensitive high-speed governor. The whole of the road-driving gear is made of crucible steel. Two speeds are provided for travelling on the road; these are thrown into and out of gear by a single lever, under the direct control of the driver, and so arranged that only one speed can be put into gear at one time, or that both speeds can be put out of gear when the engine is required for thrashing, etc. Differential gear is also fitted on the driving axle, enabling the engine to turn the sharpest curves with ease. The engine is fitted with a powerful worm and wheel steerage, and band-screw brake gear. A winding-forward drum and rope on the driving axle is provided for the purpose of hauling the engine out of difficult places, or hauling heavy loads up inclines when the engine cannot draw the load. The draw-bar is so arranged that the whole pull of the engine is taken direct from the main axle bearings, thus relieving the boiler and tank from all undue strain. The boiler is made entirely of steel, and double-riveted in all longitudinal seams and corners of firebox shell. The firebox is made of Siemens-Martin steel, and is round on the top. The firebox shell sides are carried upwards and backwards, for the purpose of carrying the different axle bearings. Messrs. Fowler also exhibited a compound traction engine to which most of the previous remarks apply. Also a very neat 8in. horizontal engine for electric-lighting purposes, a fine-furrow balance plough, and some samples of light railway plant.

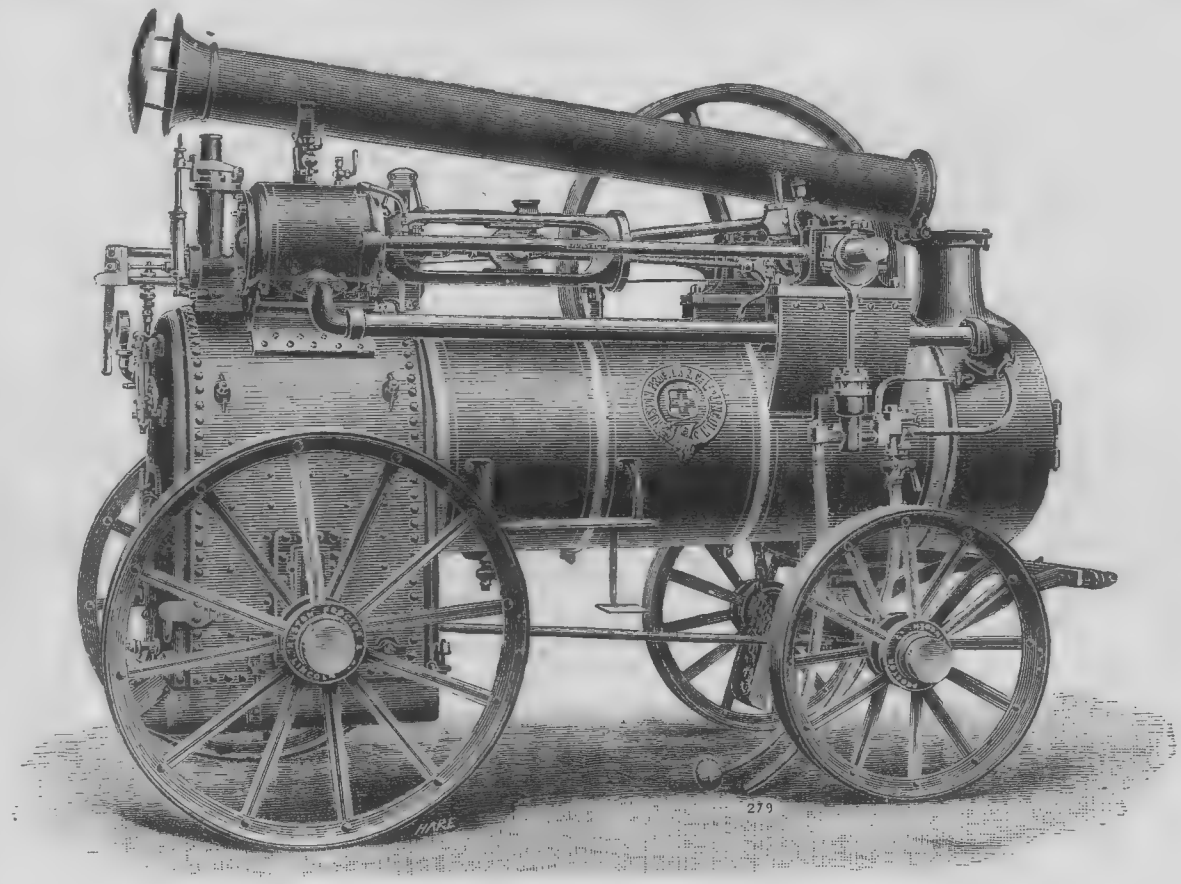

FIG. 5.—RUSTON, PROCTOR'S PORTABLE ENGINE.

Some of the best-finished engines shown were by Messrs. ROBEY AND CO., of Lincoln, the specimens of their well-known manufactures being as follow:—

A portable engine fitted with patent automatic governor and link expansion gear, giving sufficient strength in all parts without excessive weight, and being extremely simple in design; all the valves are arranged so that they are open to inspection by removing one cover only, the working parts being as few as possible, and being carefully marked so that a labourer of ordinary intelligence can take them to pieces and rearrange them without difficulty. A compound Robey engine and locomotive boiler combined, fitted with patent automatic governor and link expansion gear. A Class E horizontal fixed engine, with patent trip expansion gear. A Class D horizontal fixed engine, fitted with patent automatic governor and link expansion gear, having a wide range, enabling an engine to develop for a time, when starting or meeting with a sudden resistance, as much as five times its nominal power.

Messrs. Robey also had on view a Class D medium-stroke horizontal fixed engine, fitted with patent automatic governor and link expansion gear, as above described; a vertical high-speed engine for electric lighting purposes, fitted with lubricating arrangements for continuous running; and a vertical engine and boiler combined, fitted with high-speed equilibrium governor, suitable for driving corn mills, barn machinery, etc.

Messrs. MARSHALL, SONS AND CO. LIMITED, of Gainsborough, had on view a varied assortment of their well-known engines. One of the most prominent of these was a compound engine and boiler of the underneath type of 10N.H.P. mounted on a wrought-iron foundation frame. This engine is provided with a multitubular feed-water heater of the vertical type, with brass tubes of improved design arranged in connection with the exhaust steam from the low-pressure cylinder. The engine and boiler are of ample strength throughout for working at a steam pressure of 140lb. per sq. in. These boilers are subjected to a hydraulic test of 240lb. per sq. in. prior to leaving the works. They also exhibited specimens of their new pattern horizontal and vertical engines with the Moore patent crankshaft governor and automatic cut-off gear. The horizontal engine has a cylinder 10in. diameter by 14in. stroke, and the vertical 8in. by 12in.

Traction engines have now come into very extensive use, not only for agricultural work, but also for general haulage purposes. Messrs. Marshall have given

careful consideration to all the details of these engines, and the 6H.P. traction engine shown this year embodies many important improvements. The travelling wheels are of extra strength, riveted up by special machinery, and have recently been increased in size. The boilers are also enlarged, giving greater heating surfaces, and the side plates of the boilers are now carried up to form the horn plates. The sizes of the axles and countershafts have also been increased.

The 8H.P. portable is of the firm's usual type, and is provided with firebox for burning inferior coal as fuel. It is mounted on wrought-iron travelling wheels, with a special wrought-iron plate undergear. There was also shown a 16H.P. double-cylinder portable engine, specially adapted for contractor's and general work. A finishing thrashing machine was also shown by this firm.

Messrs. CLAYTON AND SHUTTLEWORTH exhibited one of their portable engines of 8H.P. fitted with jacketed cylinder. A highly-finished 10H.P. compound under-type engine, specially made for H.H. the Prince Hussein Pasha, Kamil, Egypt, attracted much attention. It is erected on a strong wrought-iron frame, which also supports the boiler at the firebox end. The cylinders are jacketed and fitted with automatic link expansion gear, patent high-speed governor, feed pump (to which a water heater is attached), and an injector. Some slight alteration in the position of the steam stop valve has been made in this engine, in order to secure steam as dry as possible.

A traction engine of 8H.P. was also shown. This had a jacketed cylinder and stop valve in one casting, bolted to a saddle. The entire engine is carried on wrought-iron side frames, firmly braced and stayed by cross plates, these relieving the boiler of strain to a considerable extent. The expansion of the engine is provided for by bolts and square steel dies working in long slots in the horn plates. The boiler and tubes are of steel, as are also the shafts, axles, and rods. The steerage is worked from the footplate by means of a worm and quadrant. A finishing thrashing machine and a portable chaff cutter were also included in this firm's exhibits.

The chief feature at the stand of Messrs. CHARLES BURRELL AND SONS, of Thetford, was a light compound traction engine, which has been made specially narrow for the roads of Devon and Cornwall. The width over all of the engine is 6ft., and the weight between six and seven tons. The necessary powers are provided in the gearing to enable the engine to haul loads of from 10 to 12 tons up the steepest hills. A powerful brake is fitted, capable of holding the engine under all circumstances. The arrangement of the gearing is such that no driving strain is transmitted to the axle, each road wheel being driven by gearing on each side of the engine. By this means the strains are more evenly distributed through the engine, and nearly double the surface for wear is obtained in the gearing, ensuring great durability.

Messrs. ROBINSON AND AUDEN, Wantage, exhibited the very neat and compact 7H.P. traction engine shown in Fig. 6. The boiler is stayed for a working pressure of 150lb. per square inch; the side plates are extended above and behind to carry the crank, intermediate, and main shaft bearings, which are contained in castings firmly fitted into the plate and fixed with turned bolts driven in. The gear, which is all of steel, is arranged on one side of the engine so that the belt can drive from the fly-wheel in either direction on the other side. The cylinder is steam-jacketed, and the stop and governor valves are contained in one casting, screwed into the cylinder, so that in case of necessity it can at any time be removed and replaced in a very short time. The road wheels are of wrought iron, and the spokes of the driving wheels, instead of being riveted to the tyres as is usual, are secured by turned bolts and nuts. The winding drum is so arranged that it can be worked with the axle revolving, and by this means the bosses of the driving wheels are not subject to that heavy wear which is the case when the axle has to revolve within the bosses whenever the drum is put into operation.

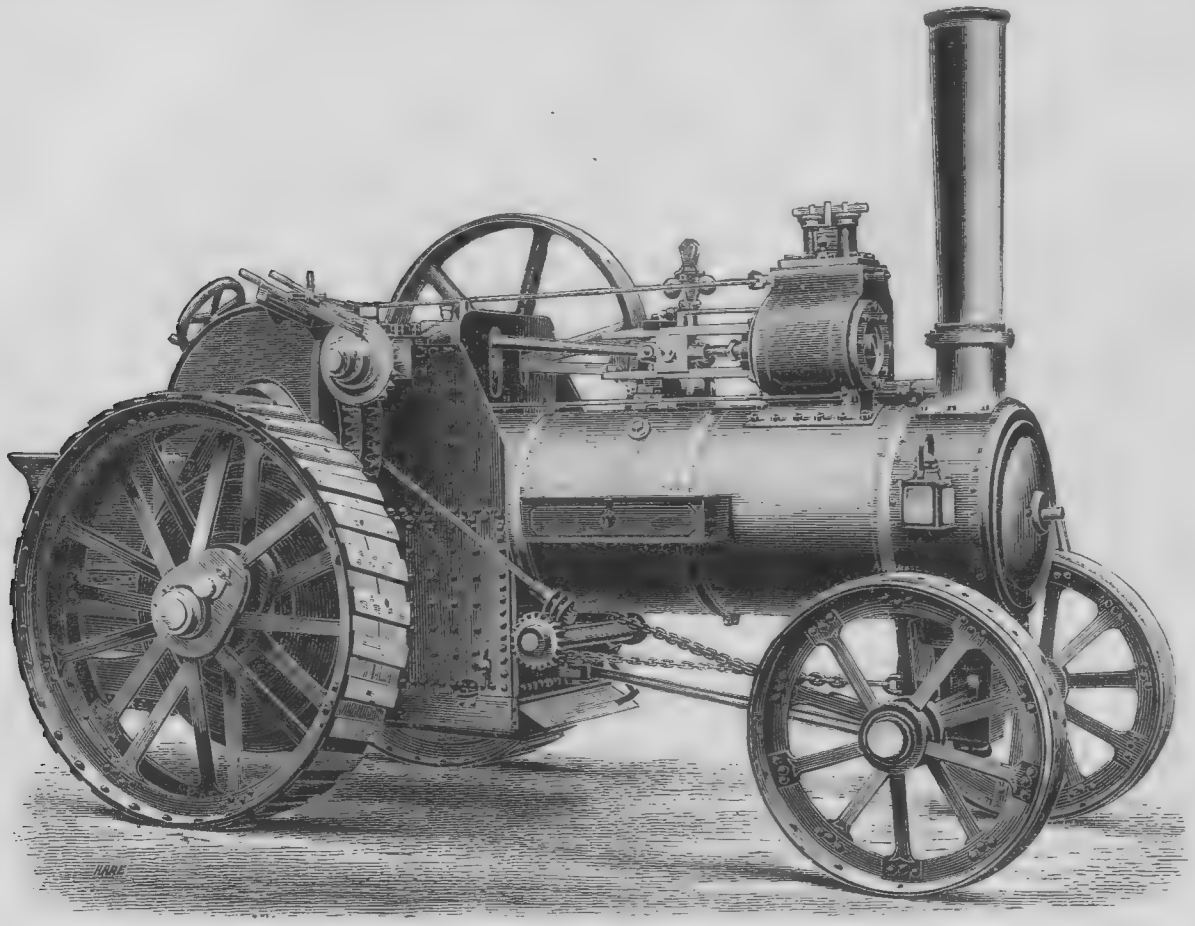

FIG. 6.—ROBINSON AND AUDEN'S TRACTION ENGINE.

This firm also showed their latest 7H.P. portable engine (Fig. 7). This engine is of substantial construction but does not call for special remark. The other exhibits included a 4H.P. vertical engine and a 4ft. 6in. "Simplissima" thrashing machine.

The exhibits of Messrs. RANSOMES, SIMS AND JEFFERIES LIMITED, of Ipswich, included a 6H.P. traction engine for a working pressure of 140lb. per square inch. All the bearings of this engine are fitted into bored holes in the side plates of the firebox shell, which are carried upward and backward for the purpose. A channel-iron draft bar is provided, which extends across the back of the tender, with deep straps welded on each side, to take the pull from the horn plates and relieve the tender from all hauling strains. There are a series of holes in the draft bar, so that the draft pins can be moved out of the centre when required for turning sharp corners with a long train.

There were also shown an 8H.P. portable engine; a 10H.P. long-stroke engine, fitted with patent automatic governor expansion gear; a 5H.P. short-stroke engine on a cast-iron foundation—in the latter engine the bedplate, crosshead guides, and plummer blocks for crankshaft being all cast in one piece, and the cylinder and valve chest bolted to the end of the foundation frame; and a 4-horse vertical engine, connected with a new patent multitubular vertical boiler (for description see MECHANICAL WORLD, July 8, 1892).

Messrs. Ransomes also exhibited a finishing thrashing machine, 54in. wide, fitted with heavy thrashing drum of large diameter running in spherical bearings, and provided with ample adjustments for dealing with all kinds of grain. A number of implements were also shown, including the Ipswich hay kicker, a double-row potato planting machine, and several ploughs.

The exhibit of Messrs. E. R. AND F. TURNER, of Ipswich, was mainly a repetition of those of previous years, consisting of portable engines and fixed steam engines, "Gippeswyk" engine and boilers. Their expansion governor appears to be well in demand, both on their own engines and on other makers' engines, apart from the engines themselves. The girder-type engine of 8H.P. on view is an example of their present practice in fixed engines, and in which they seem to get a full share of the business which is going.

A selection of their various crushing mills were also on view, their later pattern mills No. 12 and No. 13 being intended for the use of large consumers and merchants. The peculiarity of these mills is that by means of very shallow grooves at wide intervals the mills are adapted not only for crushing oats and other grain, but will at the same time break maize for horse fodder with a minimum of dust. One or two patterns of their grinding mills with

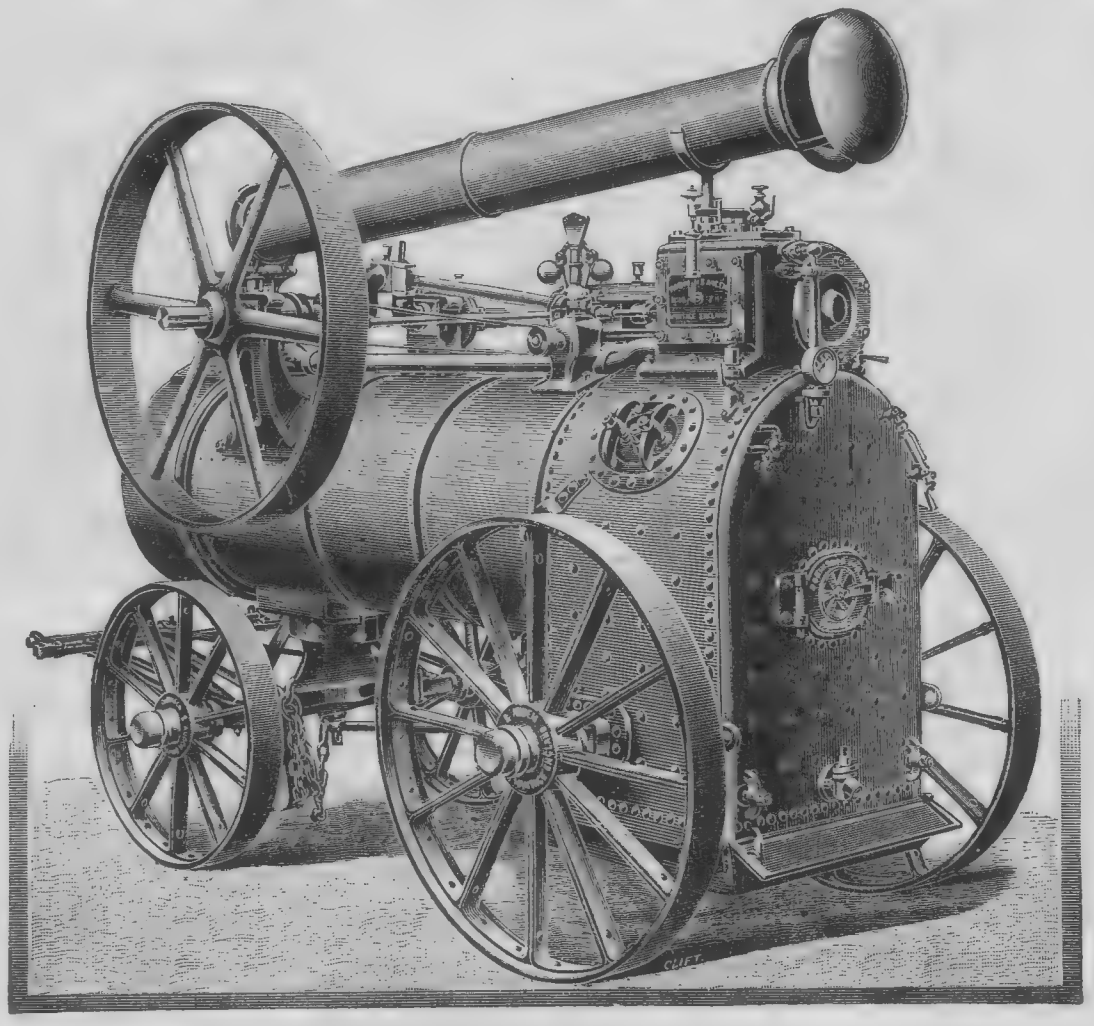

FIG. 7.—ROBINSON AND AUDEN'S PORTABLE ENGINE.

French burr stones were also shown, but need no comment from us.

As a mill specially adapted for malt and linseed crushing, Messrs. Turner show one of their four roller mills of similar construction to those used by them in their flour-mill plants. The rolls are of chilled iron with steel spindles immovably fixed therein, and the whole mill was altogether a well-finished specimen of their manufactures—a very high-class machine, entirely separate from the ordinary run of malt and linseed crushers generally, being provided with every necessary for continuous hard work; and with the further advantage that, having two pairs of rolls, the malt can be graded by the sieve which precedes the rolls, and the large and small grains can be fed one on one side and one on the other to a separate and distinct pair of rolls, actuated by separate pressure gear, so that any desired fineness of sample can be obtained.

Messrs. WALLIS AND STEEVENS, of Basingstoke, exhibited a 6H.P. traction engine which embodies several minor improvements, the principal of these being the governors, which have been newly designed.

The exhibit of Mr. W. ALLCHIN, of Northampton, consisted of a 7H.P. traction engine. The travelling wheels have recently been increased in size, and the cylinders enlarged. The main axle and other bearings have also been increased, and great attention given to the lubricating arrangements.

Messrs. AVELING AND PORTER exhibited a 6H.P. agricultural locomotive of their usual pattern; and portable engines were also shown by Messrs. BURROWS AND CO. LIMITED, of Banbury, and by Mr. J. P.

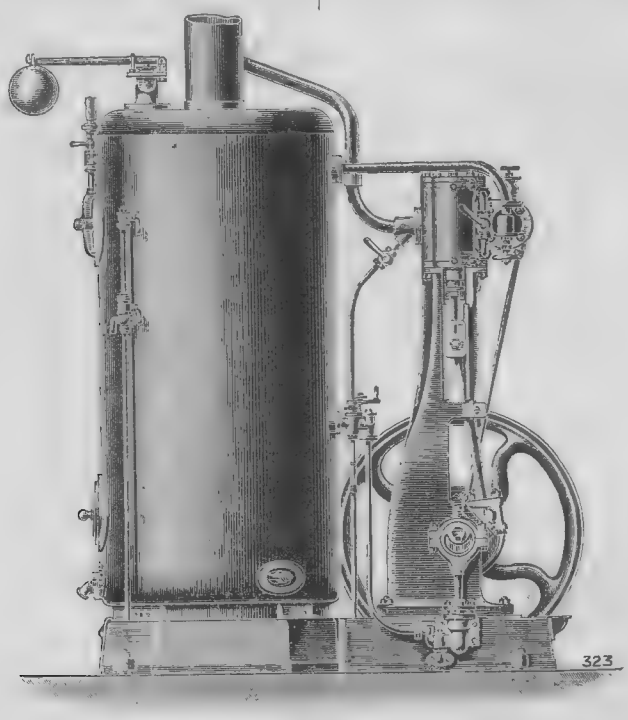

FIG. 8.—NICHOLSON'S COMPOUND ENGINE.

COULTAS, of Grantham. These do not, however, call for any special notice.

Mr. E. S. HINDLEY had on view a number of his small combined engines and boilers, and also a new high-speed electric-light engine.

Messrs. W. N. NICHOLSON AND SONS LIMITED, of Newark-on-Trent, exhibited a new 4H.P. vertical compound engine and boiler, shown in Fig. 8. As will be seen from the illustration, each piston rod is secured direct into one of the slide blocks, one crosshead pin connecting the two as shown. This makes a very neat, simple, and compact engine, and so long as the power developed in each cylinder is approximately equal, the arrangement should give every satisfaction. Only one valve of the semi-rotating type is used for both cylinders, and the movement of this is controlled by a reversible shaft governor placed within the fly-wheel. The engine is mounted upon a tank base, by the side of a steel Field-tube boiler, suitable for 120lb. working pressure. Messrs. Nicholson also exhibited an improved "Trent" kicker tedder in which the forks by a simple and ingenious arrangement of levers reproduce the action of hand-turning.

Messrs. RICHARD GARRETT AND SONS, of Leiston, Suffolk, exhibited a 40I.H.P. semi-portable compound and an 8 and a 2½I.H.P. portable single engines. All these engines are fitted with corrugated fireboxes and flanged to the boiler, and afford an excellent support for the crankshaft pedestals (Fig. 9). It will be apparent that the substitution of the Siemens-Martin steel plate for the usual cast-iron saddle or brackets, reduces the weight to a minimum. Messrs. Garrett also had on view a 4ft. 6in. finishing thrashing machine fitted with their patent beater drum and chilled bearings.

Messrs. EDWARD HUMPHRIES LIMITED, Pershore, exhibited an 8H.P. portable engine of their usual type, and also a thrashing machine.

Messrs. R. HORNSBY LIMITED, in addition to the oil engine already referred to, had on view a new light steel frame open-back binder, the weight and draught of which are very light. The binder is quite open at the rear of the machine; and it is, therefore, able to deal with crops of any height, and with less tendency to shed the corn than machines without the open-back arrangement. The machine is fitted with a steel frame, steel main-road wheel, and cutting apparatus, all of new design. Messrs. Hornsby also had on view a specimen of their new chain-drive mower. In this machine, the first motion is driven by chain, which renders the working very silent. The cutting apparatus is of a new design, ensuring clean cutting.

The Hornsby-Hoosier corn drill is an improved light-draught implement, the usual change wheels and weights on the coulter levers being dispensed with. It will sow grain in any desired quantity by simply moving a small indicator lever, and a novel device also shows the number of acres of grain sown. In this drill a new patent flexible steel spiral conductor is now used for conveying the grain from the seedbox to the coulters, and this is found to be more durable than indiarubber or tin tubes; also it cannot kink or close up so as to interfere with the free passage of any kind of seed. The firm's thrashing machinery was well represented by a large-size thrashing machine, accompanied by a portable steam engine and a powerful traction engine. The thrasher is fitted with an entirely new rotary corn screen, which operates without the use of brushes, and attached to the thrasher is a specimen of the improved Hornsby straw trusser for tying the straw into bundles. Glancing at the other exhibits on Messrs. Hornsby's stand, we noticed quite a number of highly-finished grass mowers and self-raking reapers, both for 1 and 2H.P., and including a specially light self-raking reaper for use in light and medium crops. An assortment of general-purpose and chilled digging ploughs, a turnwrest plough of a new and improved pattern, ridging ploughs, and root pulpers and cutters were also shown.

Messrs. W. AND T. AVERY LIMITED exhibited a number of their well-known weighing machines. Among these was Richardson's patent automatic grain weigher, register and feed-regulating machine. This is specially suitable for weighing granular and powdered materials, such as grain, flour, sugar, cement, etc. The machine is also capable of weighing damp grain direct from the washer. It is adapted for automatically weighing and delivering a continual stream of grain, checking the number of the weighings. It can be used by the miller for regulating the supply to his first break rolls, and so ensure an exact amount being ground per hour. The machine also adapts itself to either a varying supply from the silo and elevator, or an irregular delivery of the grain weighed. It consists of an ordinary weigh beam, weight scale, and receiving hopper quite free in their working, and being unencumbered with the usual stops and balancing weights, it may be treated as an ordinary scale. The mechanism which liberates the discharge and opens the feedgate, and which cuts off the supply from a large feed to a small dribble to ensure exactness in weighings, consists of only two working parts; these, with the necessary weights which regulate the amount of the weighings, comprise the working parts of the machine. The space occupied is, we understand, less than that by any other machine. The 20lb. size, which is capable of weighing a feed of 5000lb. per hour, has a frame only 12in. in height, thus allowing it to be placed on the top of a pair of rolls or close under an elevator. We understand that the working of this machine is very satisfactory in every respect, and it has now been adopted by the company as a staple article of their manufacture.

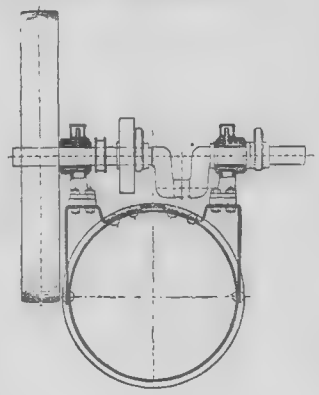

FIG. 9

A noticeable exhibit in the galleries was the collection of implements and stock-feeding machinery shown by Messrs. R. HUNT AND CO., Earl's Colne, Essex. At the stand was shown horse gears of various forms, the "Simplex" and "Atlas" chaff-cutters, maize and oat mills, and a large variety of grinding machines, root graters, etc.

Messrs. J. AND F. HOWARD, of Bedford, had on view a very effective exhibit of ploughs, harrows, kicker-tedders, sheaf-binding reapers, straw trussers, and hay and straw-baling presses.

Messrs. BAMFORDS, of Uttoxeter, exhibited a number of their "Rapid" corn-grinding mills, also a new "Rapid" corn crusher, several specimens of the firm's newly-patented chaff-cutters, mowers, etc.

Messrs. SAMUELSON AND CO. LIMITED, of Banbury, had their usual display of machinery, which included their new steel-frame sheaf-binding harvester, with low elevators open at the end to permit of long grain passing freely to the binding apparatus. They also had on view their "New Era" reaper, an improved form of light self-raking machine, fitted with four rakes, and arranged so that when used for swathing any of the rakes may be raised by the driver without stopping the machine, so as to carry the cut grain on the platform, and not discharge same when turning corners, etc. The "Dexter No. 1" grass mower is shown with covered gear and light lift for the cutter bar; also another new form of mower, having an exceptionally light form of main frame, and other alterations of a minor character.

THE HARDY PICK COMPANY LIMITED, of Sheffield, exhibited two of their well-known "Devil" disintegrators and a collection of agricultural tools. We have on previous occasions referred to the capabilities of the disintegrator made by this firm, but we may here note that the makers have ground, granulated, or shredded in the same machine, and with the same grinding rings, quartz, flint, glass, dry and wet clay, slate, lead ore, oak bark, wet and dry corn, bones (green and dry), hoofs, rags, gentian, cinchona, pepper berries, cork, coal (wet and dry), coal and pitch for briquettes, etc. In fact, the makers state that they have not yet discovered any material which the disintegrator will not deal with satisfactorily.

Messrs. S. COBBETT AND SON, Wellington, Shropshire, exhibited a large collection of grinding mills. In these machines the cutting plates are chilled, rendering them exceedingly durable, while the cost of a new pair when required is not nearly so expensive as merely recutting a steel mill or stones. The mill is fitted with a pair of spiral springs which allow a nail or other hard substance to pass through without the slightest danger of injury or breakage. There is only one running spindle working in two bearings of anti-friction metal.

Messrs. W. H. WILLCOX AND CO., Southwark-street, London, had on view a very effective collection of engine packings, including those with Willcox's cork core. We understand that this packing is now being generally adopted by the principal hydraulic companies. The cork expands and contracts, and is not in any way affected by water or grease. They also showed an assortment of indiarubber suction hose, belting, valves, washers, asbestos, and indiarubber sheeting, and had in addition a good display of leather belting, both single and double, also endless for portable and traction engines; leather laces, copper rivets, special oils for agricultural-engine owners' use, etc., including the firm's special neatsfoot and lard oil; also traction-engine oil, and an oil specially for use in the cylinders of the ploughing and traction engines. The exhibit also included samples of boiler-covering composition, steam-engine fittings and boiler mountings, sight-feed lubricators, gauge glasses, oil cans, tube brushes, engineers' tools, etc.

Messrs. HENRY POOLEY AND SON, of Liverpool, had their usual collection of weighing machinery, including their crane weighing machine.

Messrs. Bolling and Lowe's Steel and Iron Report.

THE year is drawing near its close, and we therefore take, as usual, the opportunity of placing before our friends our opinion on the condition of trade. In our report of 1891 we stated that we expected the present year would not show any improvement, and we regret to say that our anticipations have been fulfilled. On the American Continent we find that Canada has not taken so much railway and other material as customary, on account of the lessened construction of branch lines and other large undertakings. In the United States of America, the influence of the M'Kinley tariff has considerably interfered with English trade. The hope that Mr. Cleveland's election to the Presidency will alter the tariff has yet to be realised. Congress will only meet in the spring, and we have, consequently, still some months to wait before anything can be known for certain. Day by day developments of the American home industry in steel and iron take place, which go a long way towards counteracting any beneficial results likely to accrue to this country from an eventual tariff reduction. Even then, the competition between the works in the States themselves is so serious that heavy goods from this country would, as a rule, have but little chance of being imported. As regards tinplates, every effort is being made to manufacture same over there, and thus free themselves from this English "burden," as they call it. The result of a good harvest in the United States and a bad one in Europe, will enrich the former considerably, but we imagine the gains will not be expended in purchases of materials in Europe. As regards Mexico, the financial world appears to consider that sufficient support has been given to enterprises in that country, and is now rather timid, although it cannot be said that the Mexican Government has in any way failed to fulfil its obligations. The opinion is rather gaining ground that the country is being covered by more railways (in proportion to its population and development) than will be needed for some time, and such are not likely to give an adequate return on the capital invested. The Central American States have suffered under revolutions, and these have reacted on their general business. Naturally, investors have not courage to put their money into funds that are so likely to run the risk of depreciations as these are, and where the words "guarantee" and "subsidy" are so very vaguely interpreted. In South America, as a whole, matters are looking brighter as regards the ordinary merchant's trade, and the exchanges of Brazil and Argentine have improved considerably during the last few months. In the latter country and Uruguay, the position between the governments and their European creditors (holders of bonds and other securities bearing a guarantee) is not satisfactory, and there is good reason to doubt that there will be for years to come any return to the prices that ruled for the Government Stocks before the financial crisis. Chili alone has succeeded in maintaining her credit in spite of the revolution. The Australian Colonies have also laboured under financial troubles, and in consequence of the British public giving but small encouragement to new loans, their respective governments are economising, and avoid spending money on new works at the same rate as heretofore. India, which used to be the best customer of Great Britain, is depressed under the low value of the rupee. It is, therefore, not to be wondered at that the Indian Government hesitates to borrow money or give

guarantees for new railways, for which the interest has to be paid in gold though earned in silver. China.—The ordinary trade has not changed for the better; nevertheless we find here a purchaser of railway materials of a description that shows it is intended for first-class work. It is to be hoped that this is only the forerunner of further lines to be constructed. Japan.—The exports hence have not been more than to a moderate extent, but still European manufacturers regard it as the most enterprising country in the East, and look forward confidently to an extension of trade. The improvement in South Africa is an established fact, and the development of railways and mining enterprises is of such a character that capitalists are looking favourably on propositions submitted to them. The Continent of Europe has not called upon Great Britain for even the usual quantity of steel and iron, and the monetary depression has been too severe to allow more than a moderate extension of railways and municipal undertakings, for which the necessary funds had to be found by public issue. Scandinavia alone may be considered an exception.

Home Trade.—The year has shown a continued retrograde movement as regards prices of steel and iron of all kinds. It may be said that neither shipbuilders, engineers, locomotive, wagon or bridge-builders have been occupied to the full extent of their powers of production, as a natural consequence of the decreased demand from countries which used to be good customers, such as the South American States, India, the Australian Colonies, etc.; this extends its influence to shipping, bringing freights down to unremunerative figures. In years gone by large fortunes were made by individual iron and steel manufacturers, but in looking through the reports of the many limited companies that now take their place, it is seen that for years the result to shareholders has been of the most meagre kind, even if they have obtained any dividend at all. The increased wages bill is to a great extent accountable for this. The great strike in the Durham district collieries in the first half of the year inconvenienced many manufacturers of steel and iron to a large extent, and consequently decreased the output of pig iron. Shareholders of the railway companies in the North of England suffered severely in their dividends. In a few exceptional instances it gave a desirable opportunity for postponing work. From January 1 next the new railway tariffs come into force. To what extent they will interfere with traders' convenience and charges has to be seen; but that they will, in most cases, at first, cause great trouble cannot be doubted, as the basis for former calculation is altered in many instances, and the new scale is hardly likely to be in print and ready by the time the change takes place from the old to the new rates.

Labour.—Although our exports have shown great shrinkage, both in values and quantities, yet labour has not suffered in proportion. The accounts of railways and other large establishments show heavy increases of expenditure in their wages and coal bills, either in the form of direct advances in the rates of wages, or in the larger number of men employed to make up for the shorter number of hours at which the day's work has been fixed.

General Remarks.—The financial difficulties which commenced in 1890 have gone on more or less ever since, and have lately extended from the trading circles to classes that hitherto were not direct sufferers from the effects of same—viz., small investors, building societies, etc., etc. The amounts that are at stake under these headings are really very vast. This year has seen the continued ascension of the principle of amalgamation between banks in the country and the metropolis. The rate of discount has ruled even lower than generally considered desirable for sound business. Drastic measures are in prospect as regards domestic legislation, which will cause great expenditure in sanitary improvements. With the large number of unemployed in our midst, a restriction of immigration of the poor from the Continent has become an important question. If the quantity of food imported and retained by a nation for its home consumption plays any *rôle*, it may be noted that Germany, our greatest competitor, consumes annually only equal to the value of about 5s. 8d. per head against 60s. per head in Great Britain. There must soon be a period in steel and iron works when manufacturers will have to decide whether they find it more to their interest to go on working at a loss in the hope of better times, or to close their works and dismiss their men. As far as we can judge at present the prospects for 1893 cannot be called encouraging.

The "Globe" Sight-feed Lubricator, etc.

We have pleasure in directing attention to a very neat and efficient sight-feed lubricator now being placed upon the market by the Globe Engineering Company, 38, Victoria Buildings, Manchester. Fig. 1 gives a general view of the apparatus, which is shown attached to the steam pipe.

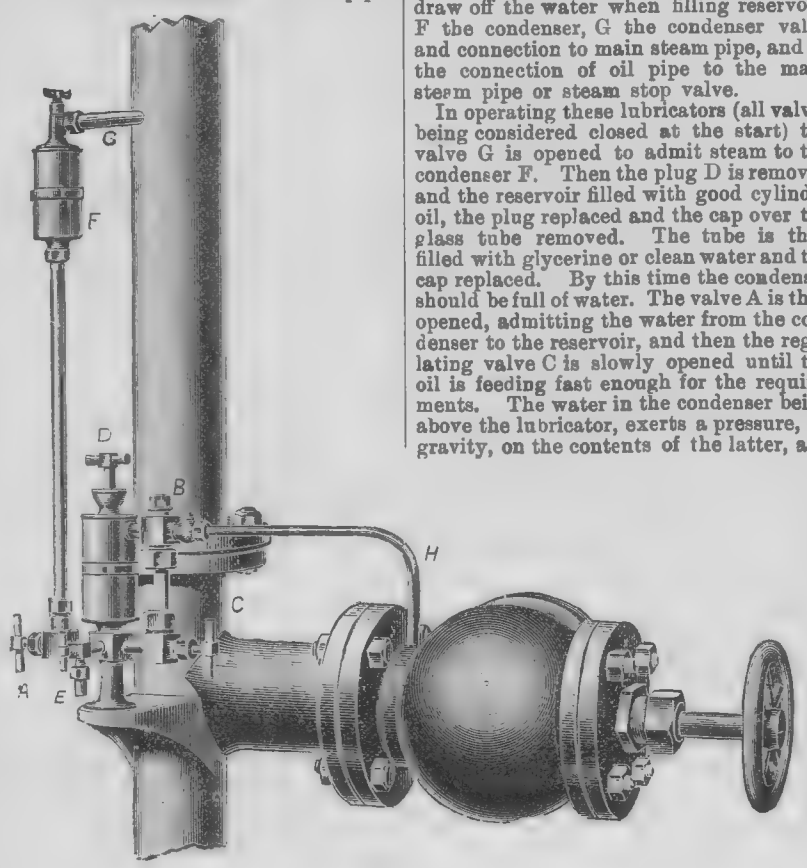

Fig. 1.

The makers rightly draw attention to the necessity for the exercise of care in making this connection, which must be made in such a manner as to ensure all the oil being properly utilised. Frequently, through thoughtlessness or carelessness, connections are so made that a large portion of the oil never reaches the engine, but is drained away with the condensed steam. There is no doubt that in many instances either the lubricator is blamed, in consequence, for not feeding properly, or the oil is considered of poor quality, when really all the trouble is due to bad arrangement of the pipes.

One point often overlooked, but which is of considerable importance, is that the oil pipe H should project at least ¼in. inside the casting or pipe to which it is connected, so that the oil will drop off the end into the current of steam, and be carried by it into the valve and cylinders, instead of trickling down the sides of the pipe and being partially wasted.

Referring to the cut, A is the inlet valve, B the outlet check valve, C the regulating valve, D the plug to be removed for filling the reservoir with oil, E the waste valve to draw off the water when filling reservoir, F the condenser, G the condenser valve and connection to main steam pipe, and H the connection of oil pipe to the main steam pipe or steam stop valve.

In operating these lubricators (all valves being considered closed at the start) the valve G is opened to admit steam to the condenser F. Then the plug D is removed and the reservoir filled with good cylinder oil, the plug replaced and the cap over the glass tube removed. The tube is then filled with glycerine or clean water and the cap replaced. By this time the condenser should be full of water. The valve A is then opened, admitting the water from the condenser to the reservoir, and then the regulating valve C is slowly opened until the oil is feeding fast enough for the requirements. The water in the condenser being above the lubricator, exerts a pressure, by gravity, on the contents of the latter, and entering the reservoir at the bottom it floats the oil to the top and forces it down through a tube, inside the reservoir, to the regulating valve C, from which the drops of oil will be seen passing up through the water in the glass tube. When the oil has all passed out of the reservoir the valves A and C are closed and the drain valve E opened, then the plug D is removed and the reservoir refilled with oil.

The illustration shows a single-feed lubricator only, but they are made with double feeds, if desired, for supplying the two cylinders of a double engine or for two supplies of oil to the same engine.

For certain situations, such as horizontal pipes, pipes below the floor level, the steam chest of an engine, or the side pipes of beam engines, a self-contained lubricator, as illustrated in Figs. 2 and 3, is more suitable. These lubricators are identical with the one illustrated in Fig. 1, except that the stand is replaced by a triple connection cock. As the pipe connections are already made, it only remains to screw the cock into a hole tapped in the pipe or casting. Referring to these illustrations: A is the triple connection cock forming the stand, C the pipe leading to the condenser, D the pipe from condenser to reservoir, and B the oil pipe from the top of glass tube to the cock (the continuation of this oil pipe inside the steam pipe is shown at E).

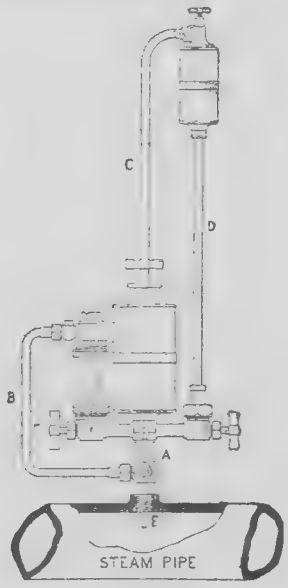

Fig. 2.

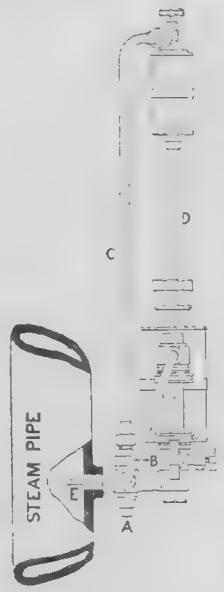

Fig. 3

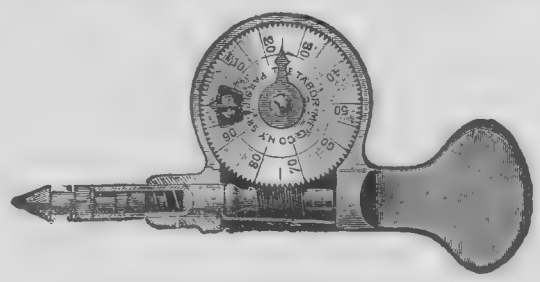

Fig. 4.

These lubricators are exceedingly well made, and may be used for all working pressures up to 200lb. per sq. in. It is claimed that they are simple in operation, and easily manipulated, while there is nothing liable to get out of order or cause trouble in any way. The feed of oil is always visible, and may be regulated with the greatest nicety to give as little or as much as required, the variation extending from a single drop in five minutes to a constant stream of oil (this applies to all sizes). A check valve (B, Fig. 1) is provided to prevent the back flow of steam if the glass tube should break, and a valve G at the top of the condenser to shut off steam if desired.

We may add that the Globe Engineering Company furnish quite a number of high-class specialities which are calculated to satisfy the most rigid requirements of the progressive engineer. Among those we may mention the Tabor indicator, the Coffin averaging instrument, Ashcroft safety valves, low-water alarms, feed water heaters, etc. These instruments and appliances we have previously illustrated on various occasions. We may, however, here refer to the Tabor revolution counter, which is shown in Fig. 4. It is supplied at an exceedingly low price, and will register up to 5000 revolutions. In this counter the point is provided with a pin clutch and is separate from the spindle, in which it can freely revolve, the clutch being held from engaging by a light spring inside the spindle, as shown in the cut. Suitable stops are provided on the end of the spindle, which engage with the clutch on the point when the spindle is pushed endwise, causing the spindle to revolve with the point and registering the revolutions.

Manufacturing v. Speculation.

It is a pity that companies whose object is the production of electrical machinery and apparatus do not confine their operations solely to manufacturing purposes, instead of partly doing so and partly exploiting subsidiary companies. If manufacturing only were done and other company schemes left alone, investors and the public generally would have greater faith in such undertakings. A case in point is the Electric Construction Corporation Limited, which was formed three or four years ago to acquire the businesses of Elwell-Parker Limited, of Wolverhampton, and of the Electrical Power Storage Company Limited. The trade of the latter has, however, since then been transferred to another company, although the Electric Construction Corporation practically holds nearly the whole of the shares in that enterprise, leaving the dynamo and other heavy electrical engineering business in Wolverhampton to be conducted by itself. Now if this had been done, many of the shareholders think, as they stated at the meeting of the company on Friday last, that the concern would be in a prosperous condition; but it seems that a large sum of the capital of the company is locked up in subsidiary companies which the directors have helped to form. The result is that for the second time the Corporation is in need of money to enable it to carry on the business. Excited were, indeed, some of the shareholders, and a committee of investigation was proposed by one who held over 5000 proxies. This motion was, however, out of order. With a view, however, to obtain fresh capital, it is now proposed to issue £100,000 in second mortgage debentures, with a bonus in the form of an income bond carrying interest as from the date of the redemption of the corresponding debentures, at a rate for each year equal to the dividend declared on the ordinary shares for the preceding year. One-half of this amount has been guaranteed, and it remains for the shareholders to take up the other half if they feel so disposed. A somewhat similar case is that of Messrs. Woodhouse and Rawson United Limited, whose meeting took place on the 22nd inst. The loss for the past year, according to the report, amounts to no less than £129,764, which is reduced to £86,734 by deducting the amount of the reserve fund and the sum of

£8030 brought forward. It would appear from these two cases that it is advisable to keep entirely distinct from each other the business of manufacturing and that of dealings in or in connection with subsidiary companies.

Manchester Association of Engineering Students.

AT the monthly meeting of the above association, held on the 17th inst., Mr. Thomas Jones, M.I.M.E., in the chair, two papers were read, one by Mr. J. Vose, on the subject: "Some Applications of Steam Jets"; and the other by Mr. H. Bates: "A Review of Machine Tools." Mr. Vose described and illustrated, by means of sketches and actual apparatus (kindly lent by Messrs. Meldrum Bros.), the various forms of steam jets, appliances, blowers, exhausters, ejectors, compressors, agitators, elevators, etc., and gave examples of their application to the various purposes. The paper concluded with a description of the Meldrum system of forced draught for boilers by means of steam jet blowers placed underneath the fire.—Mr. Bates briefly described the progress made in the construction of all kinds of machine tools, particularly the lathe, and gave modern examples by diagrams of lathes by the best local makers.—Discussion followed the reading of both papers, and the proceedings concluded with the passing of hearty votes of thanks to Mr. Vose and Mr. Bates for their very interesting papers.

Metal Trade Memoranda.

Some rich deposits of iron ore have been discovered in the province of Ekaterinoslav, Russia.

The Old Level Works, Brierley Hill, have been restarted by Messrs. Mantle and Hall for rolling bar iron.

The St. Egidy Iron and Steel Industry Company, Vienna, intend erecting a large steel plant in Hungary.

Belgium imported from Great Britain during the month of November 2559cwt. of unwrought copper, as compared with 3364cwt. in November, 1891.

At the Weardale Iron Company's Tudhoe Works, which have a capacity for producing 1000 tons of Siemens-Martin steel per week, there are being erected two additional furnaces, each of 25 tons capacity.

The South Stockton Ironworks, Thornaby-on-Tees, are now being dismantled, Mr. Arthur Bainbridge having acquired the plant for breaking-up purposes. These works, which were established as the North Yorkshire Ironworks, had a prosperous career in the days of the iron rail trade; but when iron rails were superseded by steel, the works had to be employed in manufacturing bars, etc., and have not of late years done much good for their proprietors.

New Companies.

ENGINEERING AND GENERAL CONTRACT CORPORATION LIMITED.—This company was registered on the 10th inst., with a capital of £100,000, divided into 100,000 shares of £1 each, to carry on the business of general engineers, and manufacturers of boilers, engines, furnaces of every description, and machinery of all kinds. Until otherwise determined by a general meeting, the number of directors is not to be less than 3, nor more than 7; qualification, £100. Registered by Messrs. George Reader and Co., 7, Ely-place, E.C.

RAWSON FOUNDRY COMPANY LIMITED.—This company was registered on the 8th inst., with a capital of £2000, divided into 200 shares of £10 each, to carry on the business of mechanical engineers, machine and engineering tool makers, boiler makers, ironfounders, and casters, brassfounders, millwrights, metalworkers, metallurgists, and similar trades. Registered without articles of association by Messrs. G. Jordan and Sons, 120, Chancery-lane, W.C. Registered office, Moira, Leicestershire.

PNEUMATIC WOOD-CARVING MACHINE SYNDICATE LIMITED.—This syndicate was registered on the 14th inst., with a capital of £9000, divided into 9000 shares of £1 each, to enter into an agreement; to apply for, purchase, or otherwise acquire any patents, etc., capable of being profitably dealt with, and to enter into any business transaction of whatever nature in connection therewith. The number of directors is not to be less than 2, nor more than 7; qualification, £5; remuneration of directors, £100, and £50 per annum extra for the chairman. Registered by Messrs. Rose Innes, Son and Crick, Billiter-square Buildings, E.C.

ASBESTOS COMPANY, NEWFOUNDLAND, LIMITED.—This company was registered on the 9th inst., with a capital of £10,000, divided into 10,000 shares of £1 each, to adopt and carry into effect a certain agreement, to purchase and take on lease, or in exchange, or otherwise acquire any other grants, lands, mines, or mineral properties of any description in any part of the world which the company may think can be advantageously developed; and to prospect and search for asbestos, or any minerals or metals of any description. The number of directors is not to be less than 3, nor more than 6; qualification, £250; remuneration to be fixed by the company in general meeting. Registered by Messrs. Jordan and Sons, 120, Chancery-lane, W.C. Registered office, 8, Glenlyon-terrace, Southampton.

FRENCH AND AMERICAN WHITE LEAD SYNDICATE LIMITED.—This syndicate was registered on the 10th inst., with a capital of £50,000, divided into 50,000 shares of £1 each, to acquire by purchase or otherwise patents, brevets d'invention, etc., in connection with the making of white lead or white sulphate of lead; and to carry on the business of manufacturers of and dealers in white lead, or any chemicals or substances capable of being so converted. With certain modifications, the regulations of Table A apply. Registered by Messrs. W. H. Martin and Co., 15, King-street, Guildhall, E.C., solicitors to the syndicate.

BLAIBERG AND MARSON LIMITED.—This company was registered on the 12th inst., with a capital of £25,000, divided into 2500 shares of £10 each, to acquire the business heretofore carried on by Joseph Blaiberg and Joseph Marson, under the firm or style of Blaiberg and Marson, at Bute Works, Oozells, Birmingham, to carry on the business of mechanical and general engineers, designers and constructors of engineering and other machinery, screwing tackle, screwing machines, stocks, dies, wrenches, tube vices, tube cutters, twist drills, etc., and to carry on and extend the business so acquired. The number of directors is not to be less than 2, nor more than 5; the first being Joseph Blaiberg, Jos. Marson, and Chas. Levy; qualification, £2000; remuneration, £800, to be divided among them as has already been arranged. Registered by Messrs. Jordan and Sons, 120, Chancery-lane, W.C. Registered office, Bute Works, Oozells, Birmingham.

Official Gazette.

Partnership Dissolved.

W. E. WALKER, T. WALKER, A. L. MAYNARD, W. CUNNINGHAME, and GEORGINA MARGARET S. COOKSON, under the style of Walker, Maynard and Co., Redcar Ironworks, Kirkleatham, and Middlesbrough, ironmasters; so far as relates to A. L. Maynard.

THE BANKRUPTCY ACTS, 1883 AND 1890.

Order Made on Application for Discharge.

WILLIAM HAWKES RYLAND, Birmingham, lately trading with Henry Watkins as the Birmingham Empire Wire Mills Company—bankrupt's discharge suspended for two years until Nov 17, 1894.

The Metal Market.

PRICES CURRENT.

LONDON, Dec. 19.

COPPER opened with but little offering, but buyers also holding off, and initial business showed a fall of 2s. 6d., with cash at £46 15s., which was also taken for a few days' prompt. A temporary rally to £46 16s. 3d. for ten days followed, but values again eased off and declined gradually during the remainder of the day, three months ranging from £47 1s. 3d. to £47, and near dates from £46 15s. to £46 11s. d., which was accepted for cash after the official close Final rates are easy, and 6s. 3d. lower, the loss being due to a desire to realise. Sales, 700 tons. Settlement price, £46 12s. 6d.; English tough, £51 to £51 5s.; best selected, £51 15s. to £52 5s.; strong sheets, £60.

TIN opened dull and nominal, but at the close of the first session £92 10s. was taken for sharp, cash, and later in the day the price sharply dropped to £92. The limited demand was only for prompt delivery, and cash closes 25s. and three months 10s. down. Sales 20 tons. Settlement price, £92; English ingots, £95 10s.

PIG IRON improved during early trading, buyers being more disposed to operate, and 41s. 7½d. was bid for Scotch cash, sellers asking 41s. 8d. Towards the close 41s. 7½d. cash was taken for 500 tons, and the market finished with a steady tone at 1d. advance on Friday's official values. Settlement price:—Scotch, 41s. 7d.; Middlesbrough, 37s. 7d.; hematite, 46s. 1d.

TINPLATES unchanged. I.C. cokes, f.o.b London, 12s. 9d.; Liverpool, 12s. 3d.; Swansea, 11s 9d.

LEAD is steady and fully 1s. 2d. better on limited offers, with Spanish at £9 17s. 6d.; English, £10.

SPELTER is improving, January shipment having changed hands at £18 7s. 6d., a rise of 2s 6d. Silesian specials are offering at £18 17s. 6d.

ZINC SHEETS.—Belgian are steady, V.M. brands, ex ship, £21 15s.; f.o.b. Antwerp, £21 10s. to £21 12s. 6d. Silesian quiet at £21 10s. ex ship for ordinary brands.

OFFICIAL CLOSING QUOTATIONS.

	To-day. £	s.	d.	£	s.	d.
COPPER—						
G. M. B.—Cash	46	13	9	47	1	3
" Three months	47	1	3	47	8	9
English tough	—		—	—		
Best selected	—		—	—		
Strong sheets	—		—	—		
TIN—						
Fine foreign—Cash	92	0	0	92	10	0
" " Three months	91	10	0	92	0	0
Australian—Cash	93	0	0	93	10	0
PIG IRON—					s.	d.
Scotch warrants—Cash					41	7½
" One month					41	9½
Middlesbrough—Cash					37	7½
" One month					—	
Hematite—Cash					46	1½
" One month					—	

GLASGOW, December 19.—On the pig iron market probably not more than 7000 tons of Scotch changed hands, 1000 at 41s. 7½d. with a plant, and 1000 at 41s. 8½d. cash, which was 1½d. over the opening figure. Though undealt in, Cleveland was 4½d. dearer, as it is understood there are some "short" accounts to close before the end of the year, and warrants are well held. The shipments of Scotch last week were 4764 tons, being an increase of 60 tons on the same week last year, and making the increase for the year 21,291 tons.

QUOTATIONS.

	Highest. s.	d.	Lowest. s.	d.
Scotch warrants—Cash	41	8½	41	7
" One month	41	9½	41	9
Middlesbrough—Cash	37	10½	37	6
" One month	—		—	
Hematite—Cash	46	1½	46	1½
" One month	—		—	

Trade Marks.

The following is the Official List of Applications published from December 7 to December 14, for the Registration of Trade Marks, so far as relates to the Metal Trades.

CLASS 5.

FRODAIR

167,258—2848 S. Unwrought and partly wrought metals used in manufacture. THEODOR BRUNO KITTEL, 41, Arundel-street, Sheffield, Yorkshire; merchant.—20th September, 1892.

CLASS 5.

NORRFIELD

167,260—2850 S. Unwrought and partly wrought metals used in manufacture. THEODOR BRUNO KITTEL, 41, Arundel-street, Sheffield, Yorkshire; merchant.—20th September, 1892.

Letters to the Editor.

*** *We do not hold ourselves responsible for opinions expressed by correspondents.*

*** *The name and address of the writer (not necessarily for publication) must in all cases accompany letters intended for insertion, or containing queries.*

*** *Letters intended for publication in the current week's issue must reach our Manchester Office not later than by the first post on the Tuesday preceding the date of publication.*

RELATIVE SIZES OF BOILERS AND ENGINES.

To the Editor of THE MECHANICAL WORLD.

SIR,—When an engineer has to provide a boiler to supply steam for an engine, he generally finds it difficult to decide what size of boiler to fix upon. The boiler must be able to evaporate as much steam as the engine requires. This may be said to be a known quantity; but the weight of steam any particular boiler will evaporate is pretty much of an unknown quantity.

In marine practice there are fairly trustworthy rules as to the fire-grate area necessary per I.H.P. under different conditions of draught, etc.; but in land work engineers are pretty much in the dark.

Now, sir, if any of your readers could give an idea of the best practice in the case of vertical, Cornish, Lancashire, and perhaps locomotive and multitubular boilers, I think it would be of great practical use to many.

What is wanted is: Given an engine of a certain size to run at a certain speed (or given an engine of so many I.H.P.), what size of boiler should be laid down to supply the steam, the coal being of average quality? INQUIRER.

Glasgow, Dec. 9.

ROLLER FLOUR MILLING.

To the Editor of THE MECHANICAL WORLD.

SIR,—In your issue of THE MECHANICAL WORLD for December 9, I noticed that your correspondent, "Penknife," is anxious to inveigle me in a controversy with a firm of milling engineers as to the merits of a certain wheat-washing and stoning machine manufactured by them. The machine "Penknife" refers to was article 3657 exhibited at the Warwick Show.

Now, let me assure "Penknife" that I am not so easily trapped. If he has suddenly discovered a machine that fits in with all the requirements stated in the article (he grumbles about not being up to date), so much the better for "Penknife"; his experience is considerably different to that of

THE WRITER OF THE ARTICLES.

Dec. 19.

AMERICAN AND BRITISH WORKMEN AND MACHINERY.

To the Editor of THE MECHANICAL WORLD.

SIR,—After reading the article by Mr. Jas. Arthur which appeared in your issue of the 9th inst., I am prompted to say a few words, endorsing what he has to say about American and British workmen. I served my apprenticeship as engine fitter in one of the largest railway company's works in Great Britain, and three years ago, having occasion to be in North Carolina, America, I was invited to look round the railway company's locomotive works at Wilmington, and with all deference to British practice, I am bound to say the visit was not only instructive, but an enjoyable one. I went round without any escort, and found the workmen, from foreman to labourer, exemplary not only in skill, but in politeness and civility. The habits and methods in American practice are most certainly advantageous to both workman and employer, and form a good example for British workmen. The men appear to go about the shop as though each had some personal interest in his employer's concern. The average wage of the fitters in that shop was 33 per day of nine hours.

I was also informed on good authority that all the engineers (whom we term drivers and firemen) have to serve three years in the fitting shop before being engaged on a locomotive as fireman or engineer.

I should be glad if some reader who has had more opportunities to judge will give us his experience.

AN EAST ANGLIAN FITTER.

Felixstowe, Dec. 17.

Miscellaneous Items.

An electric tramway is to be constructed at Boso, Japan.

It is understood that the Chilian Government contemplates the lighting up of the Straits of Magellan with electricity, and that the matter will soon be brought before the Chilian Legislature for its consideration.

The construction of an important railway line in the district of Usambara, Zanguebar, has been decided upon, the works to commence in March next. It is believed that the railway will materially contribute to develop agricultural enterprise in the fertile country of Usambara.

The construction of the new line of railway which is to open up a portion of the valuable mineral and agricultural districts of Northern Transvaal, the first sod of which was recently cut, is now making good progress, and the line is expected to be completed well within the contract time of two years.

At Yeovil Gasworks a strong, overflowing artesian spring has been struck by Messrs. Le Grand and Sutcliff, of London, in boring a tube well. Upon reaching a seam of rock in the marlstone series, at a depth of 132ft. 6in., the water immediately rose to 6ft. above the surface, and the copious yield proves more than sufficient for all the requirements of the place.

On the 15th inst. the Lancashire and Yorkshire Railway engineers hastily barricaded the long iron bridge which crosses the main line to Manchester in Bolton-road, Blackburn, it being discovered that the principal girder, with a span of 36ft., had cracked from top to bottom, and sunk several inches. The fracture was noticed after the passing of a heavy stone wagon, and it is believed was caused by frost.

The Post Office authorities have placed in front of the Royal Exchange, London, as an experiment, an automatic box which is intended to be an adjunct to the express delivery of letters and parcels. By dropping a penny in the slot the purchaser obtains an outer envelope, enclosing a small white envelope and card, on which the desired communication may be written, whilst resting upon a small desk which falls from the front of the box. At the same time an electric bell calls a messenger from the nearest Post Office, which is Threadneedle-street.

The heaviest swing bridge in this country was successfully turned into position at Trafford-road, on the Manchester Ship Canal, on the 13th inst. It is 265ft. long, 30ft. deep, and 50ft. wide. The approximate weight of each main girder is 230 tons, and the approximate weight of the entire structure about 1650 tons. The bridge works on 64 massive cast-iron rollers, and, when in working order, is turned round by hydraulic power. The contract has been carried out by Messrs. J. Butler and Co., Stanningley Ironworks, near Leeds.

The death is announced on the 18th inst. of Sir Richard Owen, K.C.B., F.R.S. He was born at Lancaster on July 20, 1804. He began life as a doctor in London in 1826, but shortly afterwards was appointed assistant curator of the Hunterian Museum, this appointment causing him to devote himself exclusively to the study of comparative anatomy. In 1856 he was superintendent of the Natural History Departments of the British Museum. He was one of the founders and first president of the Microscopical Society, and was a Fellow or Associate of most of the scientific societies at home and abroad.

Next year will see a new departure in the way of catering for third-class passengers. The East Coast route between London and Edinburgh is to be equipped with third-class dining-cars, and an order for four has been placed with the Oldbury Railway Carriage and Wagon Company Limited. They will be 46ft. long, and built on the American principle, with seats on each side and a gangway down the centre. At each end is a vestibule with a covered telescopic gangway leading to the adjoining kitchen car. Each car is to seat 24 passengers, and is divided into two compartments, one being for smokers. The seats will be placed transversely, and one table between each two passengers, sitting opposite each other. The cars will be provided with the Westinghouse air and also the vacuum continuous brakes for use on the different railway systems. Pope's arrangement of gas lighting is to be adopted, there being eight lights to each car. They will be heated by hot-water pipes running along the sides under each seat, the supply being obtained from the engine. Each passenger will be in electric communication with the kitchen.

A trial is about to be made in Glasgow with vitrified bricks in place of the stone and wood hitherto used in this country for street paving purposes. Brick paving is common in some Continental towns, but the difficulty of procuring the right kind of material for the manufacture of bricks in this country of a sufficient hardness and toughness has prevented that form of paving being tried for street purposes. Proper material has, it is said, now been found on the estate of Lee, near Braidwood. Whilst the material is called a clay, it is in reality a kind of hematite ore, and requires to be quarried. It is stated that the brick blocks are durable, clean, healthful, easy to repair, and comparatively noiseless, and that they are considerably cheaper than either granite or wood paving.

Queries.

☞ Readers are invited to avail themselves of this section for practical information on questions relating to Mechanical Engineering and the Scientific Industries.

☞ Queries and Replies should arrive at the Manchester Office not later than by the first post on the Tuesday preceding the date of publication.

PLOUGH BREASTS.—Can any reader inform me the best way to grind cast-iron plough breasts?—T. W.

FILTRATION.—Will any reader state the best method of filtering 150 gallons of canal water per day for steam-boiler purposes?—T. H. MITCHELL.

SWEDISH BESSEMER STEEL.—Can any reader inform me how Swedish Bessemer steel is made, and also give highest amount of carbon it contains?—FORGEMAN.

FRENCH AND ENGLISH WEIGHTS.—Can any reader inform me of a work containing tables of weights of millimetres into English pounds per metre run?—ANGLO-METRIC.

COATING FOR WATER PIPES.—Can any reader tell me how to ascertain whether cast-iron pipes have been properly coated with Dr. Smith's solution?—WATER PIPE.

BLUE PRINTING.—Can any reader kindly inform me what the necessary mixture for *extra rapid* ferro-prussiate sensitising fluid is made from, and the quantities?—FOUNDRY.

SPEED OF LOCOMOTIVES.—Provided a railway line is laid as perfect as possible, can any engine attain such a velocity as to cause it to leave the rails owing to excessive speed only?—P. T. G.

IRON MIXTURE.—Would "Foreman Pattern Maker" kindly inform me whether his mixture for chilled hammer heads would do for chilled rolls; if not, would he kindly give one?—MOULDER.

TWIST DRILL CUTTERS.—Can any reader give me a method of getting the correct thickness and shape of cutter for any diameter of twist drill, straight lip? A drawing will greatly oblige.—J. M. F.

"GRASS" PACKING.—Can any reader supply me with the address of manufacturers of this packing? I have seen it used for the piston and valve rods of L. and N.-W. railway engines.—LOCO.

HEATING FACTORIES BY AIR.—Can any reader inform me of any satisfactory system of heating a large factory by heated atmospheric air, and with what result? Also the address of the makers of the apparatus.—H. W. (Germany).

PETROLEUM.—Will any chemical correspondent kindly inform me what is the chemical constituent in petroleum that causes it generally to give off such an objectionable odour, and also by what means it is deodorised?—ODOUR.

HINTS TO DRAUGHTSMEN.—A Reader will be obliged if the author of "Hints to Young Draughtsmen" (November 18) will give a few hints for making the "nut and bolt and gas thread gauges." Where may a copy of the German round writing be had?—S. H.

PRESSED PAPER.—I shall be obliged if any reader can furnish me with names of firms in England or abroad who press paper for making trays, wheels, teeth, etc., and the widening circle of articles now made of compressed paper or pulp.—A CONSTANT READER.

GRINDING VALVES.—Will any reader advise me as to the best means of scouring brass valves and seats to a smooth face? I have tried flour emery, and a fast speed, but as I get at times different mixtures of metal in the valve and seat, I cannot smooth them both together.—W. THOMAS.

TUBE MANDRELS.—Can any reader inform me the best way to steady while turning, and also to lap when turned, a mandrel 1⅛in. × 7ft. long, to be lapped with $\frac{1}{1000}$ of taper in the whole length? I should also like to know the price per foot for the same.—TURNER.

LOSSES IN STEEL FURNACES.—Could any reader kindly inform me the average per cent. of actual loss, and the average per cent. of skull, in the charge of a Siemens open-hearth steel furnace working charges of from 30 to 40 tons? And also the percentage of loss in heating slabs and ingots in the Siemens regenerative gas furnace?—J. R. R.

THREE-THROW PUMP.—A three-throw single-acting pump has barrels 4½in. bore; 14in. stroke runs at 25 revolutions per minute. It has 3in. delivery 35ft. high; suction pipe, 10ft. high; 230ft. horizontal length, with three bends. Would 3in. suction pipe be large enough to allow pumps to work to their full capacity?—F. C.

SUGAR MILL ROLLS.—Will the writer of the article on sugar machinery or some other practical man say what is considered the best pitch angle and depth of grooves for front, top, and megass rolls, 30in. × 54in. second mill double crushing plant. What causes the juice to squirt out between top and megass rolls of the second mill? I have been told it is caused by hollow places; but in this case I am doubtful, as the rolls have no hollow places that I can see or feel by calipering. I think the distance between top roll and trash turner plate has something to do with the squirting, but opinions differ greatly.—SUGAR MILL (North Queensland).

WHEELS FOR MILLING MACHINES.—I thank "I.H.P." for his answer. The machine is a universal milling machine with a spiral head. The tangent wheel has 40 teeth, the worm has a single thread. The feed screw has four threads per inch on one, and five per inch on the other. I want to know if there is a standard number to work my own change gears out for wheels, gears, or anything I may want. I would also like to know how to find the angle of a spiral by calculations. "I. H. P." says there are two small hand-books—one by E. Holden and the other by J. Broadley. Will he tell me which he thinks is the best of the two, and the price?—TOOLS.

Replies.

☞ Owing to the constant increase in our correspondence, we regret that we have no alternative but to announce that we cannot reply by post to Queries even when stamped envelopes are sent.

☞ Queries and Replies must in all cases be accompanied by the names and addresses of the writers, as no notice will be taken of anonymous communications.

N.B.—The rings you suggest are not new.

Z.—We will give the matter our early attention.

CHIEF ENGINEER.—Messrs. Manresmann Bros., Landore, will supply you.

W. B.—Cannot you chill the outsides in casting and grind them afterwards?

DURHAM.—Hasluck's "Milling Machines and Processes," 12s. 6d. May be had from our office.

A TURNER.—We can only advise you to insert a small advertisement in THE MECHANICAL WORLD.

J. STOPHERD.—Negretti and Zambria, 38, Holborn Viaduct, London, E.C., may be able to supply you.

DUDLEY HILL READER.—You must state explicitly the vertical height of the cistern above the second pump.

NEMO.—You will have to have such blades made specially. Messrs. J. Sutcliffe and Son, in your town, would be likely to help you out.

ELECTRO.—To fully explain would take up a large amount of space. We would advise you to read Slingo and Brothers' "Electrical Engineering."

W. H.—If economy of fuel is of importance, you should most certainly have an adjustable cut-off fitted. Your cylinder ratio is not the best for the pressure. About 3½ to 1 is usual.

PIPES.—(1.) We think that Mr. B. H. Thwaite, 37, Victoria-street, Liverpool, will be able to meet your requirements. (2.) "Dynamo Construction," by Urquhart. The price is, we think, 6s. It may be had from our office.

S. A.—Your best plan is to let the lad join some good technical school, where he should pick up the rudiments of electrical engineering. Afterwards you must endeavour to place him with some firm of electrical engineers; but unless you have influence or money you will find this very difficult.

NOVICE.—You can perhaps grasp the matter by considering plain crank action. If you have a crank the pin of which is 1in. from centre, it will give a stroke of 2in., as you will admit. If now you suppose the diameter of the crankpin to be made very large so as to include the shaft, you will have such an eccentric as you mention with the throw, and consequently the stroke the same as before.

GEARING.—If the wheels are correctly arranged the pitches of each wheel and its pinion should be alike. Then the relative speeds of the wheels could be determined either by taking the relative diameters or the numbers of the teeth on the two wheels. In your case, however—which we may say is a rather unusual one,—you will require to use numbers of teeth only, and this will account for the variation of speed observed.

CONVERTING GAS ENGINES.—Will any reader kindly inform me how to convert a Crossley's gas engine, 15H.P., slide-valve type, to a tube-firing type?—FITTER.—*A.*—Messrs. Payne, Frost and Co., Bishop-street, Coventry, would like to hear from you.

WRAPPING FOR WATER PIPES.—Can any reader inform me where I can procure slag wool with canvas backing, specially made in strips, for wrapping water pipes?—W. L. K.—*A.*—You can procure slag wool strips backed with canvas from Messrs. F. Jones and Co., Ryland-road, Kentish Town, London, N.W.

Prize Competition.

WE OFFER FOUR GUINEAS MONTHLY IN PRIZES FOR THE BEST ORIGINAL ARTICLES SENT IN ON ANY MECHANICAL, ENGINEERING OR ELECTRICAL SUBJECT.

IN ORDER THAT MANAGERS, DRAUGHTSMEN, FOREMEN, AND WORKMEN WHO HAVE HAD NO PRACTICE IN WRITING MAY NOT HESITATE TO SEND IN COMPETITIONS, IT IS TO BE UNDERSTOOD THAT ALL ARTICLES WILL BE FULLY EDITED AND CORRECTED, AND JUDGED OF SOLELY ON THEIR MERITS AS ORIGINAL CONTRIBUTIONS FROM A PRACTICAL POINT OF VIEW. THE OBJECT OF THE COMPETITION IS TO INDUCE PRACTICAL MEN TO COME FORWARD AND GIVE THE RESULTS OF THEIR EXPERIENCE.

CONDITIONS.

Competitions for our Monthly Prizes must be sent so as to arrive at the Manchester Offices of THE MECHANICAL WORLD, New Bridge-street, not later than the last Tuesday in each month. Articles arriving after that time will be placed in the following month's competition.

Written competitions must be on one side of the paper only. The contributions must be original, and relate to matters connected with Engineering, Mechanism or Electricity.

The Proprietors of THE MECHANICAL WORLD reserve the right to publish any competition, whether it gains a prize or not.

The competitions may be accompanied by diagrams' sketches or drawings.

Competitors should write the words "Prize Competition" on the envelopes.

Competitors are not confined to one, but may send any number of competitions.

The correct name and address of the sender *must* be distinctly written upon every competition, not necessarily for publication. Competitions can appear under a *nom de plume*.

☞ We cannot undertake to be responsible for any MSS. sent to us, though when stamps are enclosed for the purpose we will endeavour to return rejected contributions.

Latest Inventions.

APPLICATIONS FOR LETTERS PATENT.

When Patents have been "communicated," the name of the communicating party is printed in italics.

Where complete specification accompanies application, an asterisk is suffixed

5th December, 1892.

22,207 ROTARY NUMBERING APPARATUS. L Carr and G Southey.

22,208 STEEL, IRON, or METAL PLATE. J McCallum.

22,210 APPARATUS for EFFECTING or FACILITATING ARITHMETICAL CALCULATIONS. L Lord.

22,214 MERCURIAL AIR PUMPS. L Jeyes. (*M Bloc*, Germany.)

22,225 PUMPS. T McNeish.

22,228 GAS or OIL CONSUMING BURNERS. A Gozzard.

22,229 GAS ENGINES. H I Gould and J W Bennett.

22,242 RAILWAY FOG SIGNALS. J W Dyer.

22,246 AUTOMATIC SCALE WEIGHING MACHINE. C R Gorringe.

22,249 REDUCTION of FRICTION BETWEEN ROTATING or SLIDING SHAFTS or the LIKE and THEIR BEARINGS. W S and C R Boult.

22,250 WATER TUBE BOILERS.* E de Pass. (*L M G Delaunay-Belleville*, France.)

22,251 WATER TUBE BOILERS.* E de Pass. (*L M G Delaunay-Belleville*, France.)

22,255 ADJUSTABLE BEARINGS. J L Copping and W Macpherson.

22,259 COUNTER APPARATUS for COUNTING the REVOLUTIONS of a SHAFT. J Jaquet.

22,261 ELECTRIC ARC LAMPS. A F Hills.

22,265 PLASTIC PIPE-MAKING MACHINERY. A Noel.

22,266 APPARATUS for COILING and INSERTING WIRE.* C Jackson and others.

22,267 WHEELS for RAILWAY and TRAMWAY VEHICLES and ENGINES. H S Maxim and L Silverman.

22,271 CARBONS for ELECTRIC ARC LAMPS. C W Hazeltine.

22,272 DEVICES for the DIFFUSION or TRANSFERENCE of HEAT. L P Perkins and W E Buck.

22,274 SHADE or SCREEN for ELECTRIC LIGHTS. E W Streeter.

6th December, 1892.

22,285 MICROPHONE TRANSMITTERS. G L Anders and W Kottgen.

22,291 CYLINDER SIGHT-FEED LUBRICATORS. J W Holden.

22,297 STEAM GENERATORS. H B Merton.

22,303 INCANDESCENT ELECTRIC LAMPS.* E W Applegate.

22,314 PUMPS, and VALVES for the SAME. J Corbett.

22,329 WIRE-COVERED STEAM PIPES. D B Morison.

22,330 APPLIANCES for MAKING PAPER BAGS. W Dickie and W Inglis.

22,331 STOP COCK for UNDERGROUND PIPES for WATER. D Neilson.

22,333 AMMETERS and VOLTMETERS. E Hartmann.

22,345 RAILWAY CHAIRS and KEYS. D and J M McIntosh.

22,346 TELEPHONIC SWITCHING APPARATUS. J D Miller.

22,355 ELECTRO-PRINTING SURFACES. A. Gray.

22,357 COUPLINGS for RAILWAY VEHICLES.* H H Lake. (*J W Klingler*, United States.)

22,368 LEVERS for OPERATING SIGNAL APPARATUS. E Russell.

22,369 SOFT METAL CASTINGS. W J and E Freeman.

22,370 AUTOMATIC COUPLINGS for RAILWAY CARRIAGES.* J Zehnech and F Strauch.

22,375 WELDING or WORKING METALS ELECTRICALLY.* W P Thompson. (*C L Coffin*, United States.)

22,376 APPARATUS for HANDLING or WORKING MOLTEN SUBSTANCES.* W P Thompson. (*R S Peose*, United States.)

22,379 BOILER TUBES or FURNACES. J Mackenzie.

22,382 APPARATUS for CALCULATING NAUTICAL TRAVERSE. J F Bulmer.

22,384 FURNACE BARS. C J L Hancock.

22,385 VALVES and VALVE GEAR of STEAM ENGINES. J H Tattersall and J Baxter.

22,395 STEAM TRAP APPARATUS. A G Brookes. (*F A Littlefield*, United States.)

22,397 AUTOMATIC BRAKE APPLICABLE to MARINE ENGINES. A McLucas.

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22,401 UNIVERSAL SPRING LOCK NUT. E. Derrick.

22,403 POWER PRESSES. Taylor and Challen Limited and S W Challen.

22,404 SIGNALLING on RAILWAYS. H Gilling.

22,406 JOINTING the ENDS of MALLEABLE METAL PIPES or TUBES. G Garrett.

22,407 MACHINERY for the MANUFACTURE of FUEL BRIQUETTES, FIREBRICKS, ETC. D G Sinclair and J V Dunlop.

22,409 APPARATUS for TURNING NUTS. J E Carter and S A Wright.

22,410 MACHINES for MILLING NUTS, SCREWS, or KEYS. J E Carter and S A Wright.

22,413 COMBINED GOVERNOR and VALVE GEAR for STEAM MOTORS. M Paul, jun.

22,422 AUTOMATIC ELECTRICAL CALL APPARATUS. N Khem.

22,424 ENGINE SPEED CONTROLLERS. S Miller.

22,428 STEAM ENGINES. W H Scott.

22,429 STUFFING BOXES or GLANDS of ENGINES and PUMPS. J Moorhouse.

22,448 SPRING CLUTCH APPLICABLE to ADJUSTABLE WRENCHES, ETC. W G Arthur.

22,454 STAFF SYSTEM in WORKING LINES of RAILWAYS.* J Stevens. (*C W Kinder*, China.)

22,467 TUBULAR STEAM BOILERS. J O O'Brien. (*E Scherding*, France.)

22,473 DYNAMO ELECTRIC MACHINES. C E L Brown.

22,481 PURIFYING FEED WATER for STEAM GENERATORS. G A Farini.

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22,484 BALANCED COMPOUND LOCOMOTIVE ENGINES. C A Ball.

22,486 WINDING and COILING GEAR. C H Looker and A Lampitt.

22,493 BELTS or BANDS for DRIVING MACHINERY. J Lever.

22,512 GAS and PETROLEUM ENGINES. G H Padgham.

22,516 BOILER TUBE PLATES. J H Heck.

22,520 MACHINERY for FORGING NUTS. J Leyland.

22,536 APPARATUS for STARTING GAS or OIL MOTOR ENGINES. F H Anderson and H W Bradley.

22,547 MACHINERY for MANUFACTURING WOODEN BUNGS and PEGS. W H Bailey.

22,552 CATCHING the SPARKS ESCAPING from the CHIMNEYS of LOCOMOTIVE ENGINES. E Eisenach and K Gollmer.

22,554 RAILWAY RAIL JACKS.* J M Wright.

22,562 LOCKS and KEYS. J W Toops.

22,568 FURNACE TUBES or FLUES for STEAM BOILERS. D B Morison.

22,570 DRIVING WHEELS, PULLEYS, and DRUMS T C J Thomas.

22,578 TUBE EXPANDERS for MARINE and OTHER MULTITUBULAR BOILERS. G W Chambers.

22,588 PERIPHERY TURBINE. Sir W Vavasour, Bart.

22,589 ELECTRIC SWITCHES. W M Mordey.

9th December, 1892.

22,594 FEED-WATER HEATERS. W H Spencer.

22,597 PRESSURE REDUCING VALVES. R Cockburn.

22,598 WOVEN DRIVING BELTS. J C Fisher and E Welsby

22,599 BELT FASTENERS. I Jackson.

22,601 CONVERTING IRON or LOW-GRADE STEEL into HIGH-GRADE STEEL. W R Renshaw. (*F G Bates*, United States.)

22,603 DREDGING VESSELS. J Clark.

22,609 RAILWAY SIGNALS. J Gardner and others.

22,611 PETROLEUM and OTHER LIQUID HYDROCARBON MOTORS. S Griffin.

22,615 ELECTRIC CURRENT METERS. M B Field.

22,616 GOVERNOR for REGULATING the SPEED of MARINE ENGINES. A C Franklin.

22,623 LOCOMOTIVE STEAM BOILER.* G J Perkins.

22,644 STEAM BOILERS. W R Renshaw.

22,650 SIGNALLING on RAILWAYS. A T Waterfield and W J Earles.

22,657 ELECTRIC ACCUMULATOR. J G Lorrain. (*M Dumont*, France.)

22,660 APPARATUS for TESTING the STRENGTH of WIRE. B B and W J Glover.

22,662 SMOKE-CONSUMING FURNACES of STEAM BOILERS. R Shackleton.

22,664 SELF-STARTING MECHANISM for HYDRO-CARBON ENGINES. H A Stuart and C R Binney.

22,665 PUMPS.* J Y Johnson. (*The Company Maschinenfabrik Gritzner Actiengesellschaft*, Germany.)

22,673 BOILER FEED-WATER HEATER and PURIFIER. J Kay.

10th December, 1892.

22,677 TUBES for TUBULAR BOILERS. G Quick.

22,693 BENDING METAL PIPES. W Sumner.

22,697 AUTOMATIC SINGLE-BEAT EQUILIBRIUM STEAM-REDUCING VALVE. W Hamblin.

22,705 HOT-WATER SUPPLY APPARATUS. I Evans and H McKenzie Speakman.

22,706 METHOD of STARTING GAS or OIL MOTOR ENGINES. F H Anderson.

22,711 WOOD and LIKE SCREWS. H I Gould and J W Bennett.

22,713 STEERING APPLIANCES for VESSELS and in CONNECTION WITH PROPELLERS THEREFOR. H I Gould and J W Bennett.

22,723 PORTABLE PUMP. J H Stone.

22,726 APPARATUS for SIGNALLING. F G W J Adams.

22,730 RAILWAY and TRAMWAY RAILS. W Curtis.

22,735 TOOLS for the MANUFACTURE of CRANK SHAFTS. W Somers and E G Thomas.

22,753 HOSE COUPLING.* G Terlinden.

22,758 GRINDING and CRUSHING MILLS.* H H Lake. (*Die Actiengesellschaft Grusonwerk*, Germany.)

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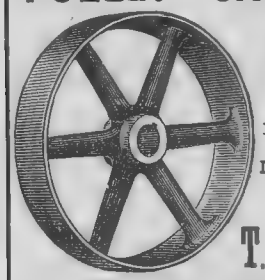

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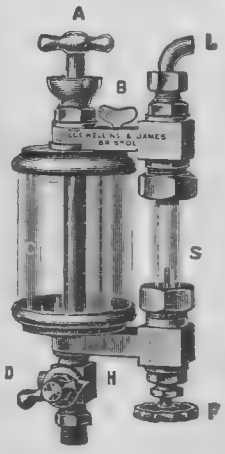

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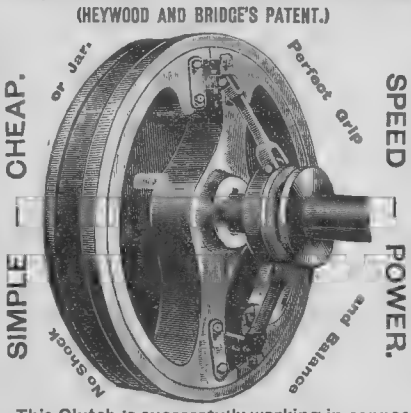

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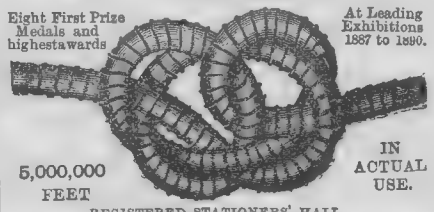

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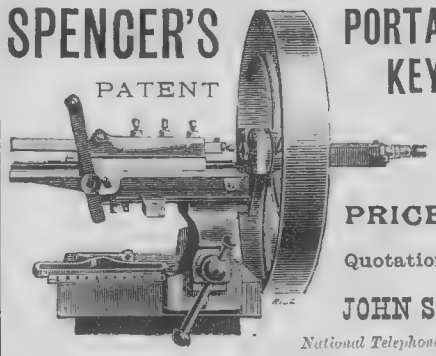

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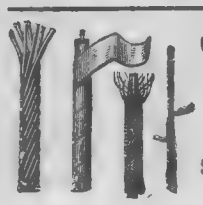

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FRIDAY, DECEMBER 30TH, 1892.

Trials of the "Scylla."

THE official trials of the new second-class cruiser, Her Majesty's ship "Scylla," built by Messrs. Samuda Brothers Limited, and engined by Messrs. John Penn and Sons, which is the last of her type of vessel ordered under the Naval Defence Act, took place on the 15th and 17th insts. On Thursday the vessel underwent her natural-draught trial, when the mean indicated horse-power developed was 7622 and the maximum 8128, with an air pressure in the stokeholds of two-tenths of an inch, the contract power for this trial being 7000 indicated horse. On Saturday the four hours forced-draught full-power trial took place, the results of which were, with a mean of 138·6 revolutions of engines per minute, steam 145lb. per square inch and vacuum 27·5; the mean indicated horse-power realised was 9280·5, giving a speed of ship of 20·625 knots, the vessel drawing 13ft. 3in. forward and 17ft. 5in. aft, the conditions in the case of this latter trial being that 9000 indicated horse-power should be developed with a speed of 20 knots. The "Scylla" is fitted with triple expansion twin engines having cylinders 33½in., 49in., and 74in. in diameter, for high, intermediate, and low-pressure cylinders respectively, each with a piston stroke of 39in. Steam is supplied by three double-ended boilers 13ft. 2in. diameter, and 18ft. 6in. long, and two single-ended ones 13ft. 2in. diameter and 9ft. 6in. long, having 24 furnaces in all, each 3ft. 6in. mean diameter, the aggregate heating surface being 15,770 square feet, and the grate surface 590 square feet. Both trials of the "Scylla" were highly successful, the forced-draught one especially, in view of the trouble that has lately been experienced at similar trials, and proves her to be one of the fastest cruisers in Her Majesty's Navy.

Electric Lighting in Zurich.

A NEW central electric-light installation has recently been inaugurated at Zurich. Even up to the year 1890 there were in operation in that town and district no less than 47 private installations, which supplied 214 arc and 3530 incandescent lamps. At that time the Zurich town administration decided to erect a municipal station on a mixed system, with four continuous-current dynamos for the arc lighting of the streets, and six alternators for glow lamp lighting. The reason for the adoption of the two methods was because it was then considered that the alternating-current system was less suitable than the continuous-current method for arc illumination. It was, however, found that this combination, taking into consideration the extent of the town and the necessity for a double set of mains and transformer stations, would greatly increase the expenses. Accordingly, it was decided towards the end of 1891 to give up the combined station, and to exclusively adopt the alternating-current system. A station on this method has been built by the Oerlikon Engineering Works. The motive power is partly obtained from the falls of the Limmat, and as the supply fluctuates considerably, it was resolved to combine this with steam power. This renders the working expenses higher, since coal is dear. The central station is erected in conjunction with the municipal waterworks in the "Letten." It contains two low-pressure turbines of 350H.P. combined, a 300H.P. compound steam engine, a 300H.P. and two 30H.P. high-pressure turbines, the latter being used for driving the exciting dynamos. The current is produced by two alternators of 300H.P. each, and two more of the same output have yet to be installed. The station was first designed for the simultaneous supply of 6000 lamps, although the mains are capable of carrying current for 12,000 lamps. The current is first conveyed by means of three cables from the station to a switch-house in the town at a pressure of 2000 volts, and from there to the transformer stations, of which there are at present nine in existence. The supply from these to the houses is arranged on the three-wire system. At present 3200 lamps, averaging 16C.P., are in use, and 30 arc for private and 45 arc lamps for public lighting. Electrical illumination does not rapidly extend, because the municipality levies a tax of 10 francs per annum on each glow lamp installed, and this prevents many persons from adopting the light. The charge for electrical energy is about ⅝d. per 100 watts. It is very probable that the tax of 10 francs per glow lamp will be abolished.

The Progress of Gas Lighting.

IT is now becoming a recognised fact that the introduction of the electric light does not have any effect in the way of reducing the consumption of gas; far from it: for as the former progresses so does the latter. If driven out of one door, it seems that gas enters two or three others. Confirmation of this fact is to be found in two Parliamentary reports just issued on gas undertakings in the United Kingdom during 1891-92. We are all tolerably familiar with the rapid extension of electric lighting, and it will also be as well to note the development in gas illumination. The number of gas undertakings authorised and in the hands of companies is 422, and belonging to local authorities 182, making a total of 604. The aggregate capital paid up and borrowed amounts to over £63,000,000. The consumption of gas during the year increased by more than 4,000,000,000 cubic feet, whilst at the same time about 1,000,000 tons of coal in excess of that of the previous year were carbonised. Gas is a necessity of the times, and will, we should imagine, always occupy a prominent position; it can scarcely be regarded as a rival to the electric light, or *vice versâ*. Its principal competitor is oil, and we can see no reason for assuming in the matter of consumption that gas will fall in the rear for lighting and heating purposes.

The Electric Light at Nelson.

ON Friday last the electric-light installation which the Nelson Corporation have established was formally inaugurated. It was stated that Nelson had achieved the distinction of being the first Lancashire town where the Corporation had completed a public electric lighting installation. The distributing main cables are laid in the main streets of the town, and tradesmen have become guarantors for the use of about 450 lights, the cost of the installation to be wholly met by the consumers of the light. The Corporation have also placed a large lamp of 2000 candle illuminating power in the centre of the town, and it is intended to place a similar lamp in front of the market. The cost of the installation, which has been carried out by Mr. T. Barton, of Blackburn, has been about £4000. The generating station is at the Corporation Gasworks, and the steam pressure of 80lb. required for driving the engine is supplied by waste heat from the retort house, thus economising the cost of working the installation. The engine and dynamo are capable of supplying electricity for 600 lamps of 16C.P. each. The distributing main cables by which the electricity generated in the station is conveyed to the premises of consumers are enclosed in an iron trough placed underground, the cables being composed of 61 copper wires, insulated in the usual way.

Municipal Electric Lighting.

THE first municipal authority in London to undertake the supply of electric light was, as will doubtless be remembered, the St. Pancras Vestry, who have perhaps done more to popularise this illuminant than any other local body in the Metropolis. Commenced in November, 1890, the generating station was erected, equipped, and started to supply light in November, 1891. Since then a great development in this method of illumination has taken place in that part of the Metropolis. Some particulars concerning the general working results during the past year will doubtless prove of more than usual interest. The total cost of the installation was £91,493, which was raised by means of loans. The working expenditure, which amounted to £6552, extended over a period of one year, whilst the receipts, which were for the year pure and simple, reached the sum of £7620, leaving a balance of £1068. These figures are given in a report just issued by the Vestry, and which refers favourably to the undertaking in a manner which seems entirely justified. It is noteworthy that since the station was set in operation there has not been a single failure in the supply of light, although there are now some thousands of lamps connected to the mains. In addition to these the principal streets in the district are lighted by means of arc lamps. The whole of the plant is not in use, and in order to work that which is idle it is proposed to raise an additional sum of £30,000. The St. Pancras Vestry, it must be admitted, adopted a wise policy in becoming purveyors of electric light and power, although very little in the latter direction has as yet been done.

Desulphurising Iron and Steel.

AT a meeting of the Cleveland Institution of Engineers, on the 19th inst., Mr. E. H. Saniter, of Wigan, and formerly of Middlesbrough, read a paper on the "Desulphurising of Iron and Steel by the Calcium Oxychloride Process." As the matter has an important bearing on steel making, the paper attracted a large attendance. Mr. Saniter said that the result of a large series of experiments showed that while lime had a very considerable effect in eliminating sulphur, the time required was excessive and the results uncertain; but that when a mixture of calcium chloride and lime was used, sulphur on the experimental scale was completely eliminated; and that when sulphury iron containing manganese was fused in a crucible lined with an infusible mixture of calcium-chloride and lime, the sulphur was removed by the oxychloride lining, leaving the manganese in the metal. If it were desirable to remove the sulphur without affecting the silicon, the calcium chloride must be dried; but when it was desired to remove silicon as well as sulphur, the wet calcium chloride must be used. The cost of materials at present prices was about 6d. per ton of iron treated, but this increased cost was more than compensated for by the cheaper production of a better quality of pig. The ability to regulate the silicon and sulphur in basic, Cleveland, and hematite irons in this matter opened the way for the use of direct metal in the open-hearth furnace. In his process, as applied to the basic open hearth, sulphury iron and residues, such as purple ore containing much sulphur, might be used, and not only was the sulphur not increased in the steel, but a very considerable elimination took place. Over 5000 tons of steel had now been manufactured from sulphury iron by the Wigan Coal and Iron Company, the sulphur being removed in the steel furnace, and the process was being successfully worked by them at the present time, the quality of steel made being as good as that from pure basic iron; while, owing to the reduced consumption of ore and scrap, a carefully carried out trial had shown a reduction of 4s. per ton on the cost of the ingots.

Shipbuilding on the Wear.

THE important industry of shipbuilding at Sunderland has during the year now drawing to a close been maintained in a very satisfactory state. Twelve firms have launched vessels, against thirteen firms last year, and they have constructed 76 steamers or sailing ships. This shows a decrease of ten vessels this year, but the average size has been greater, with the result that the gross tonnage in 1892 is 190,802, compared with 185,226 tons launched last year, or an increase of 5576 tons. All the vessels were built of steel, which material has now quite superseded iron. The firm of Messrs. J. L. Thompson and Sons have made a record so far as Sunderland is concerned, having built thirteen vessels of 37,649 tons—the largest amount of tonnage launched in any previous year by one firm having been 32,145 tons. Several fine passenger steamers have been constructed, and Messrs. Doxford and Sons have the honour of having launched the largest cargo boat afloat, the "Samoa," with a deadweight carrying capacity of 9250 tons. The prospects for the new year are by no means bright, several of the firms having got through their orders, while others have only a few to go on with. Already a large number of men have been paid off, and more are likely to be discharged weekly. During the year the engineering trade of the port has also been kept busy, but, like the shipbuilding industry, it is now very slack.

MESSRS. CAIRD AND CO. LIMITED, Greenock, have contracted with the Peninsular and Oriental Steam Navigation Company to build a cargo steamer of 4300 tons and 3000H.P.

MESSRS. DORMAN, LONG AND CO., Britannia Steel Works, Middlesbrough, have discharged the whole of their men, on account of extensive alterations that are to be made in their works. It is expected that the works will be restarted in about a month.

Strains in the Rims of Fly-band Wheels Produced by Centrifugal Force.*

THE strains developed in fly-wheels and pulleys are of an extremely complex nature, so that the numerous rules and formulæ employed for proportioning them are almost entirely empirical in character. Experience and judgment have dictated largely the thickness of the rim, while the eye has played an important part in determining the shape and taper of the arms.

In text books on machine design are found analyses of the strains in pulley arms due either to the pull of belt, the inertia of the rim, or the centrifugal pull on the arms due to weight of rim, etc. These text books also state that the strength of the rim is not affected by its thickness as regards centrifugal force; for with an increase of thickness there goes an increase of weight, with a corresponding increase of centrifugal force and area of cross-section to resist it. From this reasoning, wheels of good metal, perfectly true and in good running balance, are only limited in speed by a periphery velocity, roughly assumed at about a mile per minute, or 88ft. per second, a speed giving a very low strain per square inch of rim—to wit, about 800lb. per square inch of rim cross-section.

Yet in view of these statements we find wheels bursting at low speed, others running safely at high speed.

In saw-mill practice, where belts travel at high speed, bursting pulleys have given so much trouble that heavier rims and arms for this service have become common when cast-iron wheels are used. Sometimes even solid disc wheels are employed.

In electric lighting plants many receiving and tightening pulleys have failed, causing serious or casual disaster, according to circumstances.

Within a few years very large fly-band wheels, with wide, thin rims, have taken the place of fly-wheels with square rims, and have also been operated at very high speed. The writer knows of one case where the periphery velocity on a 17ft. 9in. wheel is over 7500ft. per minute.

In band-saw mills the blade of the saw is now operated successfully over wheels 8 and 9ft. in diameter, at a periphery velocity of 9000 to 10,000ft. per minute. These wheels are of cast iron throughout, of heavy thickness, with a large number of arms. Who would dare to operate an ordinary 9ft. pulley at that speed?

In shingle machines and chipping machines, where cast-iron discs from 2 to 5ft. in diameter are employed, with knives inserted radially, the speed is frequently 10,000 to 11,000ft. per minute at the periphery.

In view of the disasters so common of late to large band fly-wheels running at slower speeds than these, it seems probable that the strains set up in wheels by centrifugal force have not been fully considered.

Last spring the writer was one of three experts called in to decide upon the cause of a serious fly-wheel accident. From the testimony submitted by a well-known builder of large wheels, he was led to investigate a special strain developed by centrifugal force in band wheel rims. This strain is due to the fact that all materials have elasticity, and stretch when under strain. The wheel in question was 22ft. in diameter, 50in. face, and had a periphery speed of 5000ft. per minute. It was built in sections, as so many large wheels usually are (see Fig. 1). The segments were secured to arms in such a manner that the segmental joints lay half way between the arms. This construction was criticised by the aforesaid builder, who indicated by a sketch (see Fig. 2) a better method. This formed the starting point for the investigation, which the writer wishes to submit for discussion.

A thin annular ring (Fig. 3) 1in. wide and t inches thick, revolving about a central axis A, is subjected to a simple tensile strain, similar in every respect to that found in a boiler shell, its amount per square inch T being $\frac{V^2}{10}$, when V equals velocity of rim in feet per second. This can be shown as follows:—

Let r = radius of ring in inches.

R = " " feet = $\frac{r}{12}$.

V = velocity of " " per second.

The tensile strain T in pounds per square inch of rim section, due to bursting pressure per square inch p, with a ring thickness t in inches, is

$$T = \frac{pr}{t} \quad \ldots\ldots(1)$$

* Paper by James B. Stanwood, read at the New York Meeting of the A.S.M.E.

Each pound weight of ring exerts a bursting pressure due to centrifugal force

$$= \frac{V^2}{32{\cdot}2\ R} \quad \ldots\ldots(2)$$

or for each inch in length of ring it will be

$$\frac{V^2}{32{\cdot}2} \times \frac{12}{r} \times 0{\cdot}261\ t = p \quad \ldots\ldots(3)$$

Substituting in (1) we have:—

$$T = \frac{\frac{V^2}{32{\cdot}2} \times \frac{12}{r} \times 0{\cdot}261\ t \times r}{t} = \frac{V^2}{10} \text{ nearly} \quad \ldots(4)$$

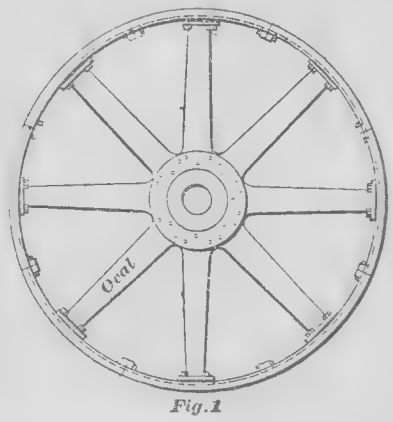


Fig. 1

Under this strain the ring expands. If C be taken as the modulus of elasticity, this expansion will amount to $\frac{0{\cdot}314\ V^2\ d}{C}$ in the circumference of the ring.

If arms are inserted in the ring, and are supposed at first to have no weight and to be rigid, with no elasticity, their effect will be to pull the expanded ring into its original diameter at the arms. It will then have the form diagrammatically exaggerated, as shown by Fig. 4.

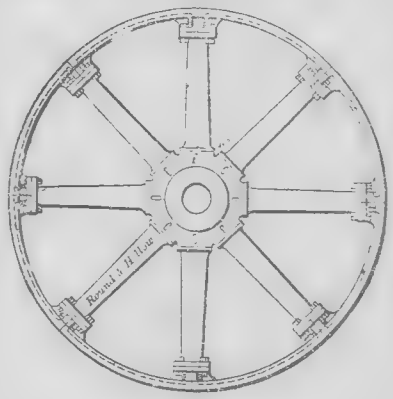


Fig. 2

Under these conditions what will be the strain upon the ring? The ring between each arm resembles now a uniformly loaded rectangular beam fixed at both ends; it is also under a tensile strain of $\frac{V^2}{10}$ pounds.

The greatest strain in pounds per square inch F to which any fibre is subjected can be expressed generally thus:—

$$F = \frac{pl^2}{2t^2} \times \frac{V}{10} \quad \ldots\ldots(5)$$

where l represents in inches the distance from centre to centre of arms, p the uniform load in pounds per square inch on the length l, and t = thickness of rim in inches. The width is assumed to be unity.

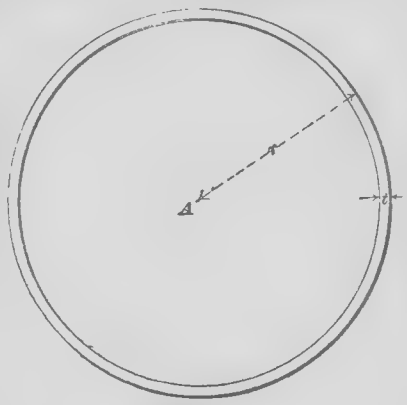


Fig. 3

This formula can be expanded by substituting for p its value $\frac{V^2}{32{\cdot}2} \times \frac{24}{d} \times 0{\cdot}261\ t$ (from 3), where d = diameter of the ring in inches = $2r$, and for l its value $\frac{3{\cdot}14\ d}{N^2}$ (6)

where N = number of arms. Then

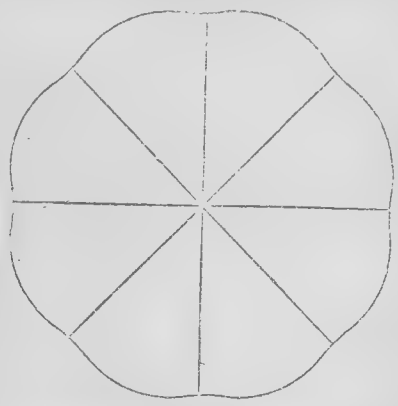
$$F = \frac{\frac{3{\cdot}14^2 d}{N} \times \frac{V^2}{32{\cdot}2} \times \frac{24}{d} \times 0{\cdot}261\ t}{2t^2} - + \frac{V^2}{10} \quad \ldots\ldots(6)$$

$$= \frac{0{\cdot}95 d\ V^2}{N^2 t} + \frac{V^2}{10} \quad \ldots\ldots(7)$$

$$\text{or } F = V^2\left(\frac{0{\cdot}95\ d}{N^2\ t} + \frac{1}{10}\right) \quad \ldots\ldots(8)$$

$$\text{or } t = \frac{0{\cdot}95\ d}{N^2\left(\frac{F}{V^2} - \frac{1}{10}\right)} \quad \ldots\ldots(9)$$

But the ends of the arms do not remain rigid; the arms themselves expand longitudinally under the influence of their own centrifugal force, and they are also elongated by the strain outward imposed upon them by the expanding ring. In fact, a compromise is effected; the arm stretches out to the ring, the ring yields in towards the arm, and the bending action in the ring depends upon this undeterminate amount. It appears, therefore, that the strain F cannot equal the value as derived by equation



(8). By a careful comparison of rim thicknesses, as determined by equation (9), with good practice t is found to be too large. On the contrary, $\frac{t}{2}$ gives consistent results, and reasonably so, for roughly the arms can be assumed to expand one-half of the amount that the ring expands diametrically. When the arms are few in number and of large cross-section, the ring will be strained transversely to a greater degree than with a greater number of lighter arms. To illustrate the necessary rim thicknesses for various rim velocities, pulley diameters,

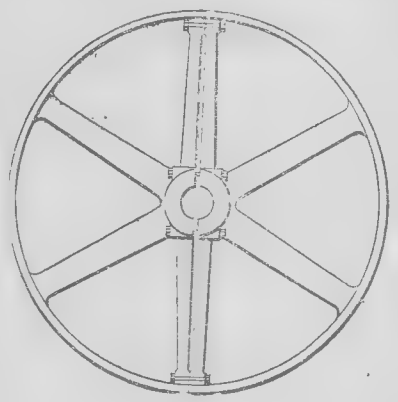


Fig. 5.

number of arms, etc., the following table is submitted, based upon the formula

$$t = \frac{0{\cdot}475\ d}{N^2\left(\frac{F}{V^2} - \frac{1}{10}\right)} \quad \ldots\ldots(10)$$

This is half the value given by (9), and the value of F is taken at 6000lb. per square inch.

THICKNESS OF RIMS IN SOLID WHEELS.

Di'meter of Pulley in inches.	Velocity of Rim in feet per second.	Velocity of Rim in feet per minute.	No. of Arms.	Thickness in inches.
24	50	3,000	6	$\frac{7}{16}$
24	88	5.280	6	$\frac{15}{16}$
48	83	5,280	6	$\frac{15}{16}$
108	184	11.040	16	$2\frac{1}{2}$†
108	184	11,040	36	$\frac{7}{8}$†

If the limit of rim velocity for all wheels be assumed to be 88ft. per second, equal to 1 mile per minute, F = 6000lb., the formula becomes:—

† These are the calculated thicknesses for a band-saw wheel 9ft. in diameter, with 390 revolutions per minute. The actual thicknesses as made were found to be 2½in. with 16 arms, and ⅞in. with 33—1⅛in. steel arms.

$$t = \frac{0{\cdot}475 d}{0{\cdot}67 N^2} = 0{\cdot}7\ \frac{d}{N^2} \quad \ldots\ldots(11)$$

When wheels are made in halves or in sections, the bending strain may be such as to make t greater than that given above. Thus, when the joint comes half-way between the arms, the bending action is similar to a beam supported simply at the ends, uniformly loaded, and t is 50 per cent. greater. Then the formula becomes:

$$t = \frac{0{\cdot}712 d}{N^2\left(\frac{F}{V^2} - \frac{1}{10}\right)} \quad \ldots\ldots(12)$$

or for a fixed maximum rim velocity of 88ft. per second, and F = 6000lb.,

$$t = \frac{1{\cdot}05 d}{N^2} \quad \ldots\ldots(13)$$

It is a fact that wheels do spring out at the joint when cast in halves or sections, for the writer has frequently tested them when they have shown this state of affairs. For this reason the construction for segmental wheels shown by Fig. 2 is preferable to that shown by Fig 1.

Wheels in halves, if *very thin rims* are to be employed, should have double arms along the line of separation (Fig. 5). Compare the thickness of the rim of a wheel made in segments or in halves, the joint half-way between the arms (Fig. 1), with the thickness of the rim as constructed in Fig. 2. For example, take a 20ft. wheel at 88ft. rim velocity per second, with 10 arms. When constructed according to Fig. 1, t must be 2½in.; according to Fig. 2, 1⅛in.

Attention should be given to the proportions of large receiving and tightening pulleys. The thickness of rim for a 48in. wheel (shown in table), with a rim velocity of 88ft. per second, is $\frac{15}{16}$in. This should be carefully noted. Many wrecks have been caused by the failure of receiving or tightening pulleys whose rims have been too thin.

A word of caution should be given to engine builders and engineers. Wheels may be specified to be made too light in weight; for with a given diameter and weight there is a minimum safe weight, dependent upon the principles already set forth. Fly-wheels calculated for a given coefficient of steadiness are frequently lighter than the minimum safe weight. This is true especially of large wheels.

A rough guide to the minimum weight of wheels can be deduced from our formulæ. The arms, hub, lugs, etc., usually form from one-quarter to one-third the entire weight of the wheel. If b represents the face of a wheel in inches, the weight of the rim (considered as a simple annular ring) will be:—

$$w = 0{\cdot}82\ dtb \text{ pounds} \quad \ldots\ldots(14)$$

If the limit of speed is 88ft. per second, then for solid wheels:—

$$t = 0{\cdot}7\frac{d}{N^2} \quad \ldots\ldots(11)$$

For sectional wheels (joint between arms):—

$$t = \frac{1{\cdot}05 d}{N^2} \quad \ldots\ldots(13)$$

Substituting in (14) we have: weight of rim for solid wheels:—

$$w = \frac{0{\cdot}57\ d^2\ b}{N^2} \text{ in pounds} \quad \ldots(15)$$

Weight of rim in sectional wheels with joints between arms:—

$$w = \frac{0{\cdot}86\ d^2\ b}{N^2} \text{ in pounds} \quad \ldots(16)$$

Total weight of wheel: for solid wheel:—

$$W = \frac{0{\cdot}76\ d^2\ b}{N^2} \text{ to } \frac{0{\cdot}86\ d^2\ b}{N^2} \text{ in pounds} \quad (17)$$

For segmental wheels with joint between arms:—

$$W = \frac{1{\cdot}05\ d^2\ b}{N^2} \text{ to } \frac{1{\cdot}3\ d^2\ b}{N^2} \text{ in pounds} \quad (18)$$

This investigation has not the advantage of extreme accuracy, but it tends to show a relation which ought to be observed. The constants used may be modified by further experience.

The value of F = 6000lb. is taken at one-sixth of Rankine's ultimate breaking strength of cast-iron when under traverse strain. The factor of safety is, therefore, 6. It should be remembered that in wheels this factor can be rapidly diminished; thus the strain varies nearly as the rim velocity squared, and if the velocity is doubled the strain is quadrupled, and the factor of safety is reduced from 6 to less than 2.

MESSRS. WEBSTER AND CO., of Deptford, have just completed the manufacture of a large steel wire rope six miles in length, and 35 tons in weight.

Improved Workmen's Time Checker.

THE illustrations herewith show a simple form of workmen's time checker, invented by Messrs. Howard and Smethurst, 314, Stamford-street, Ashton-under-Lyne. The apparatus consists of a substantial case, in the upper part of which is a very strong and well-made clock, the "going" part of which serves to directly actuate the time-checking apparatus. This latter consists of a special set of cut wheels, which slowly rotate one or more vertical cylinders, through which are sloping passages or ducts leading to separate divisions or drawers in the lower part of the case, Fig. 2. The numbered checks, which are of the usual size, are passed through slots in the front plate (Fig. 1), and by means of the sloping passages in the cylinder are conducted into the drawers before mentioned, thus keeping an infallible record of the workmen's time. The apparatus may be set so as to come into operation at any given time—say, for example, at six o'clock in the morning. The six o'clock slot is opened 20 minutes before the hour, and it can either be arranged to close precisely at the hour or a few minutes grace can be given. The slot remains closed until 6-10, then it reopens and remains open until 6-30, and so on. Provision is made for a repeating action, should the apparatus stop owing to neglect in winding. The machine is wound up once a week, and as each part is under lock and key, it cannot possibly be tampered with.

Among the several advantages claimed for the apparatus are :—The time requires booking only once a day ; it is perfectly accurate in recording ; it can be arranged to register any number of men ; moreover, it takes up but little room, and can be managed by a boy. We may add that we have seen the machine in operation, and can testify to the sound workmanship which has been bestowed upon the mechanism. The apparatus appears to be very reliable, and it is certainly very simple.

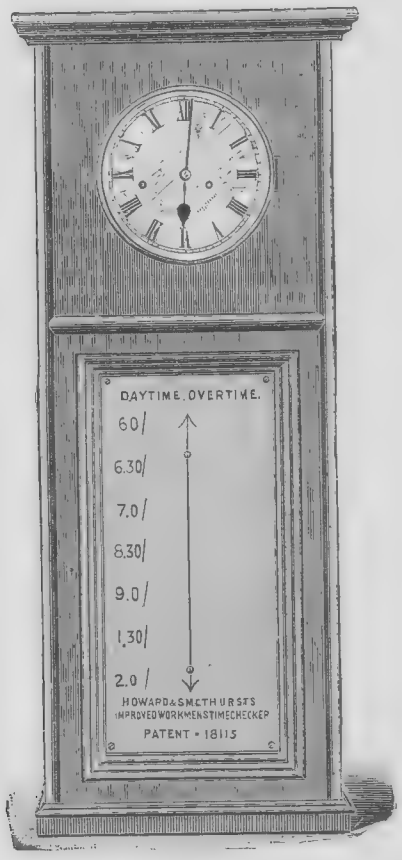


FIG. 1.

FIG. 2. IMPROVED WORKMEN'S TIME CHECKER.

MECHANICAL AND ENGINEERING DRAWING.—We have pleasure in announcing that in our next issue we shall commence a series of practical papers on "Mechanical and Engineering Drawing." These will be specially prepared by a Professor of Engineering Drawing, who is also a practical engineering draughtsman. We have every reason to believe that these articles will be very acceptable not only to students and apprentices, but also to a large section of our readers generally. We may add that the first portion of the series will be devoted to the consideration of the principles underlying the science, and the latter portion to the practical application of these to the everyday work of the mechanical engineer.

Testing and Analysis of Iron and Steel.—XIII.

BY MESSRS. LEADBEATER AND HODGSON (*Analytical Chemists*).

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DETERMINATION OF GRAPHITE.

ABOUT 4grms. of the pig iron are weighed out and introduced into a wide Bohemian beaker. The exact amount to take for the analysis may be determined by considering what percentage of graphite may be expected in the sample. For instance, with grey pig iron we shall have more graphite to weigh at the end of the operation than if mottled pig iron was under examination, consequently we need not weigh out so much iron for the determination ; in that case about 2grms. would be enough.

A little dilute hydrochloric acid is then introduced into the beaker and the cover replaced. When the first violent action is over, some strong hydrochloric acid is added and the beaker placed on the hotplate and gradually heated until the liquid boils gently.

The cover is frequently to be removed and the sides of the beaker washed down with hot water from the wash bottle. When it is judged that the iron is all dissolved, a tube pipette is half filled with nitric acid and a few drops cautiously added to the beaker, the cover being slightly tilted on one side for the introduction of the pipette. The beaker should, however, be removed from the hotplate previous to the addition of nitric acid and allowed to cool a little, otherwise the reaction will be very violent, more especially if the solution is at all concentrated.

The addition of nitric acid is continued drop by drop until the liquid assumes a yellow colour, showing that all the iron has been oxidised. Hot water is added and the solution kept at a gentle heat for an hour.

A good-sized flask *c* is now cleaned out and fitted up in the manner shown in Fig. 36. The cork is of indiarubber, and makes an air-tight connection between the tubes and the flask. The wide tube *b* has a small plug *e* of ignited asbestos at the bottom, and a small funnel *a* fitting loosely at the top. The tube *d* may be attached to a filter pump, in default of which, however, the lips may be applied for the removal of air from the flask during the filtering operation ; but in this case a short length of rubber tube with a pinchcock attached should be connected, so that when the lips are removed the cock may be closed, and thus still retain a reduction of pressure inside the flask. The flask should hold about a litre, or more. A little hot water should be sucked through the asbestos plug, and then the solution from the beaker, with the graphite in suspension, poured a little at a time into the tube, care being taken to suck the first lot through before another portion is added.

When all the solution is filtered, the beaker is well washed with hot hydrochloric acid and the sides rubbed with a glass rod upon which is placed a piece of rubber tube. The washings from the beaker are then passed through the tube as before, after which hot water and hot dilute hydrochloric acid are alternately passed through the tube until the plug is well washed and free from all traces of iron. Hot water alone is then passed through until the last traces of acid are removed.

The filtering tube is now removed and placed in a drying oven, and dry air occasionally sucked through it until all moisture has disappeared. The plug must now be forced out by introducing a wire up the narrow end of the tube and pushing it forward until the plug drops out into a little platinum combustion boat placed to receive it. If any particles of carbon still adhere to the sides of the tube they must be removed by rubbing them with a tuft of asbestos on the end of a wire, the asbestos being afterwards added to that already in the dish.

The platinum boat is now introduced into a combustion tube, which is fitted up in an exactly similar way to that used for the determination of total carbon by dry combustion, with the addition of a little bulb tube containing a solution of sulphate of silver in strong sulphuric acid. This tube is connected directly after the combustion tube itself, and serves to absorb any traces of hydrochloric acid or chlorine which may still be retained in the plug owing to imperfect washing.

The combustion is conducted exactly as previously described, and when finished the results are calculated in the same way.

This method gives very accurate results, but for ordinary purposes the combustion may be dispensed with and the carbon and asbestos weighed together along with the platinum boat. The whole is then placed in a furnace and heated to redness until all the carbon has been burnt off, when it is again weighed: the difference between the first and second weighing is the amount of graphite. This can then be easily calculated into percentage.

The more usual method is, however, after the dissolution of the iron and subsequent addition of nitric acid and water, to filter the liquid through a weighed filter paper. Two papers are taken of the same size and folded separately ; they are placed on the balance pans and the heaviest trimmed down by cutting small pieces off the apex, so as to make a hole in the filter, until they are both of exactly the same weight. The one with the hole in it is placed inside a funnel and pressed tightly round it, the other paper being placed inside the first one, and the two moistened with hot water.

The solution from the beaker is filtered through both papers, and after all the graphite and admixed silica is on the filter the beaker is washed, as usual. Finally, the two filter papers are washed with boiling hydrochloric acid until all yellowness is removed from the paper ; boiling water is then substituted for the acid, and used until the washings no longer give a precipitate with silver nitrate. The funnel is allowed to drain thoroughly, and is then placed in a water oven until the papers are crisp and dry. They are then removed from the funnel and separated ; the inner one, which contains all the graphite, is placed on one pan of the balance, and the outer one is placed on the opposite pan. Weights are added to restore the equilibrium, and the exact quantity noted. The two filter papers are again placed one inside the other and returned with the funnel to the water oven and kept there for about an hour, when they are again weighed, as before, and the decrease in weight noted. This operation is repeated several times until the filters cease to lose weight, the last weight being taken as the correct one. Now, as the filter paper on the one pan exactly balances that on the other, because they were adjusted previously, those weights used to counterbalance the filter containing the carbon, etc., represent the weight of the carbon and admixed silica alone, so that we have at once the weight of the carbon (graphite) contained in the iron, plus a portion of the silica obtained from the silicon contained in it.

We now proceed to determine the amount of silica which is mixed with the carbon. The paper containing it is therefore placed

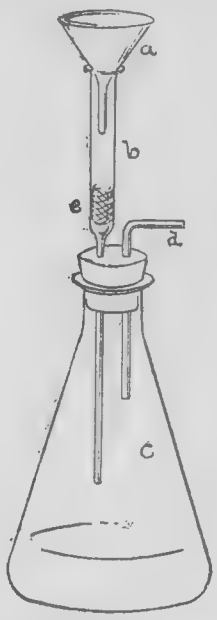


FIG. 36.

in a crucible, and the whole heated to redness in a furnace until the carbon is burnt off and the residue is quite white. For this purpose it is best to remove the lid of the crucible to allow a free access of air. The residue in the crucible is, of course, the silica, plus the filter ash. We thus have —after weighing and subtracting the weight of the crucible and filter ash—the weight of the silica, and so the amount of carbon is then readily obtained.

Example :—

Weight of pig iron taken, 2·0000grms.

Weight of $SiO_2 + C$ ..... = 0·1860grm.
Weight of SiO_2 (from below) = 0·1236

Weight of carbon ..... = 0·0624 ,,

Weight of crucible + SiO_2 + ash = 10·4370
Weight of crucible + ash ..... = 10·3134

Weight of SiO_2 ..... = 0·1236

$$\text{Percentage of carbon} = \frac{0{\cdot}0624 \times 100}{2} = 0{\cdot}0624 \times 50$$

= 3·12 per cent.

As we have previously determined the total carbon, we can, by subtracting the amount of graphite, obtain the amount of combined carbon. This is seldom done, the usual way being to determine the graphite and the combined carbon, and then, by adding them together, obtain the percentage of total carbon indirectly, and, of course, with a much less expenditure of time.

The usual method of determining combined carbon directly is that known as Eggertz's. This method is founded upon the fact that solutions of iron—containing combined carbon—in nitric acid, with an equal volume of water, have a brown tint, the depth of which tint varies in direct proportion with the amount of combined carbon present, a solution of carbon—free iron in pure nitric acid being colourless. The acid used for this determination must be absolutely pure, the slightest trace of chlorine completely masking the colour due to the carbon

by the stronger yellow of ferric chloride. The colour is compared with that of a solution made by dissolving a standard iron, the composition of which is known, in an exactly similar quantity of acid and water, and under the same conditions. If wrought iron is under examination, the standard must be wrought iron of known composition. Acid Bessemer steels must be compared with acid Bessemer steel, and basic steel with the same class of basic steel. The reason for this is that the colour varies slightly with different materials; thus, basic steel gives a colour which has a greenish cast when compared with a solution of acid steel. Each kind of steel appears to have a tint which is peculiar to it. The presence of chromium, nickel, etc., affects the determination slightly, but will be treated with in their proper place. It appears to be useless for blister steel, and also fails if the steel has been hardened. Again, it only gives correct results when the carbon is below 0·6 or 0·7 per cent.

Artificial standards are sometimes used to save the trouble and loss of time of preparing a fresh standard for each determination. They are usually made by digesting ground roasted coffee in alcohol, and diluting with water until several standards have been matched. The solutions are then introduced into similar tubes to those used for dissolving the steel under examination, and these are afterwards hermetically sealed to prevent evaporation and decomposition. Any number of tubes may be prepared, each representing the colour produced by steel containing a certain percentage of carbon. They are then arranged in a rack in proper order, the first one representing 0·01 per cent., the next 0·02 per cent., and so on. The best way is to arrange them in a long test-tube stand, missing a hole between every one in order to allow of the insertion of the trial tube during the comparison, a piece of white opal glass being placed behind for a background.

These standards, however, are not recommended, as it is always best to prepare a fresh standard for every few determinations. The particular class of steel can then always be matched and greater accuracy obtained.

(To be continued.)

Peat as Fuel.

THE Legislative Assembly of Ontario recently established a Bureau of Mines, and Mr. Archibald Blue, the director, has just issued his first report on the position and prospects of mining industry in the province. Considerable space is devoted to the subject of peat, and the possibility of utilising the vast stores of that material as a substitute for coal, which at present has to be imported to the value of over £300,000 annually. Peat is found in all the provinces of Canada, the bogs of New Brunswick and Quebec being very extensive. In Ontario, Logan in "The Geology of Canada" (1863) says: It occurs in the township of Caledonia, where its thickness does not appear to exceed 3 or 4ft.; also at the sources of the Pain river in Roxburgh, Osnabruck, and Finch, and in Clarence, Cumberland, and Gloucester. In the third, fourth, and fifth ranges of the latter township is a tract known as the Mer Bleue, which consists of two long peat bogs separated by a narrow ridge of higher land, and occupying each about 2500 acres. These deposits were sounded in many places with a rod to the depth of 21ft. without finding bottom; in other parts the peat was from 8 to 15ft. in thickness. This tract is situate only three miles from the Ottawa, and is about 280ft. above the level of the sea. Three large areas of peat of from 1000 to 3000 acres each occur in Nepean and Goulbourn, one of them to the east and two to the west of the village of Richmond. It is also found on the third and eighth ranges of Beckwith, to the east of Mississippi lake; and an area of about 3000 acres of peat occurs in Westmeath in the rear of front A, and from the first to the fifth range behind it. In the ninth and tenth ranges of Huntley there are about 2500 acres of peat, which in some parts has a thickness of 8 or 10ft., while in other parts no bottom was found at a depth of 15ft. It is probable that peat may be met with in many other localities throughout this region.

With regard to the methods of preparing peat for fuel, the question naturally arises: Why it is that, with these abundant stores of raw material and the large demand which would greet a first-class article furnished at a cost less than that of coal, no one has yet succeeded in placing such an article upon the market? Many attempts have been made to do so, for the successful inventor's reward in a coalless country like Ontario would certainly be a golden one; but up to the present the desired end has not been attained. Indeed, so formidable have the difficulties proved themselves that the belief is sometimes expressed that the problem is nearly an insoluble one. The history of the numerous attempts which have been made to produce a first-class article from the raw material by an economical process, though by no means upholding this view, is a record of partial successes only.

It is doubtless true that in the United States, where coal is plentiful and cheap, the introduction of a new article of fuel does not possess the same degree of importance as in Ontario, where coal does not exist, and where it is of necessity dear; and it may be safely asserted that the amount of popular prejudice which a really good peat fuel would have to overcome in Ontario would be very small indeed. Such an article would be received on its merits, and if it successfully stood the test of everyday use, would rapidly come into general employment. The fact that some of the largest consumers of coal in Canada, notably the Grand Trunk and Canadian Pacific railway companies, have experimented with peat in the hope of finding an efficient and economical fuel which they would be warranted in adopting, shows that a hearty recognition awaits the inventive skill of the man who shall place such a fuel at the service of the public. It may be conceded that if no better fuel could be had than air-dried peat produced from the raw material in the ordinary way, valuable as this is, the likelihood of its ever taking the place of coal to any appreciable degree would be remote; but experience shows that it is quite practicable to obtain a first-class fuel by means of a number of known processes more or less differing from one another. The difficulty with them all has been very largely one of cost. It has not hitherto seemed practicable to expel the water from the raw peat and reduce it to a sufficient degree of density without incurring an expense which precluded the possibility of its competing with coal. The fault has not been so much with the quality of the fuel, and indeed much evidence can be adduced testifying to the good properties and high calorific value of the manufactured article.

Sir Robert Kane, who, in his "Industrial Resources of Ireland" and elsewhere, has given much information on the subject of peat in that country, states that the average result of a great number of experiments made in Irish bogs shows that the general mass of the undrained peat, including both the lighter and the denser varieties, contains from 92 to 95 per cent. of water, while the edges of the bog and parts more or less drained, in the state in which peat is usually cut, contain from 88 to 91 per cent. The turf, as used in that country, often holds from 20 to 35 per cent. of water, while that which has been stacked from six to twelve months still retains from 18 to 20 per cent., and that which has been kept in a dry house for two years from 10 to 15 per cent. of water. Air-dried uncompressed peat is a very bulky fuel, its specific gravity being about 0·85, while that of coal is from 1·25 to 1 29. The essential operations, then, in the manufacture of condensed peat are, first, to get rid of the water, and, second, to reduce the material to a density more nearly resembling that of coal.

The process patented by Linning in 1837, and used at Ekman's ironworks in Sweden, has been followed substantially by many other experimenters. The peat is first ground to a homogeneous mass in a pug-mill similar to that used by brickmakers, afterwards moulded into convenient shapes and consolidated by a hydraulic or other press, after which the blocks are dried by artificial heat. An excellent fuel is the result. This is substantially the method adopted by Weber, of Staltach, in Southern Bavaria; by Gysser, of Freiburg, who invented a portable hand-machine to bring the operation within the reach of persons of limited means, and dried his blocks in the air only; by Schlickeysen, who also dispensed with artificial heat for drying, and by numerous other inventors on the continent of Europe. The common feature of these processes is the grinding or triturating of the peat into a pasty mass, the end being to reduce it in bulk. Charcoal prepared from peat manufactured in this way is said to be much firmer, more compact, and better suited for heating purposes than that made from either air dried peat or peat which has been subjected to compression only.

Williams's plan at Cappogue, Ireland, was to place the ground peat between cloths and subject it to a powerful hydraulic press. By this means he succeeded in reducing it to one-half its original weight, and one-third its volume. The remaining water was, however, difficult to be expelled from the consolidated peat, and the more fibrous varieties expanded a good deal in drying. This experiment was afterwards repeated on a considerable scale by the Irish Peat Company, and with similar results. They also built large drying-houses, in which attempts were made to dry ordinary peat by artificial heat; but the quantity of fuel required to expel the great amount of water from the peat was found to be so considerable that the process was not economical.

A plan followed at Rosenheim, in Southern Bavaria, is, after drying the peat in the ordinary manner, to pulverise it by passing it through rollers; then to drive off the remaining water by heat and consolidate the dry powder by powerful pressure. The peat is made into small blocks of 8 to 10oz., weighing from 70lb. to 80lb. per cubic foot, which corresponds to a specific gravity of 1·25, or nearly that of bituminous coal.

(To be continued.)

Shipbuilding Notes.

Messrs. Workman, Clark and Co. Limited, Belfast, launched a steel sailing ship on the 21st inst. The dimensions are:—Length, 171ft.; breadth, 27·35ft.; depth, 13·1ft.; with a gross tonnage of about 450 tons.

The Ailsa Shipbuilding Company, Troon, have contracted to build a sailing ship of 3600 tons deadweight for a Glasgow firm; and are also arranging with another firm in that town for the construction of a ship to replace one lost.

The Ailsa Shipbuilding Co. launched, on the 20th inst., a steel screw steamer, 162ft. 3in. by 25ft. 6in. by 12ft. 7in. She is to be fitted with compound engines, having cylinders 21in. and 42in. diameter, by 30in. stroke, by Messrs. Muir and Houston, Glasgow.

Messrs. William Hamilton and Co.'s Glen and Newark yards were reopened for work on the 22nd inst. On the 21st inst., a deputation of the district delegates of the Iron Shipbuilders' Society waited on Messrs. Hamilton, and after a lengthy discussion resolved to remove the barrier in the yards, the result being that the yards were reopened as above stated.

On the 20th inst., Messrs. Wm. Gray and Co. Limited, West Hartlepool, launched a steel screw steamer which has been built to the order of Messrs. John Cory and Son, of Cardiff. This vessel is 310ft. long over all, 40ft. beam, and 22ft. 2½in. depth moulded. The builders will supply the engines, which are of the triple-expansion type of 1100H.P. There will be two large steel boilers to work at a pressure of 160lb. per square inch.

Another important addition was made on the 22nd inst. to the Navy, by the completion at Chatham Dockyard of the new first-class cruiser "Hawke," built and fitted out there under the Naval Defence Act. The total cost of the vessel, including £150,000 for machinery and guns, has been £334,000, being several thousands less than the Admiralty estimate, and £30,000 less than her sister ship the "Edgar," built at Devonport. The saving has been effected on dockyard work.

There was launched from the Walker shipyard of Messrs. Sir W. G. Armstrong, Mitchell and Co., on the 20th inst., the steel screw steamer "Baku Standard." Her dimensions are:—Length, 342·6ft.; breadth, 43·3ft.; depth moulded, 31ft.; and she is capable of carrying about 4800 tons deadweight on a moderate draught of water. After the launch the vessel was taken to the works of the Wallsend Slipway and Engineering Company, where she will receive her engines, which are of the triple-expansion type.

On the 21st inst. there was launched from the shipbuilding and engineering works of Messrs. Alex. Stephen and Sons, Linthouse, a steel screw schooner-rigged steamer, of about 4400 tons gross register. Her dimensions are:—Length, extreme, 393ft.; breadth, 46ft.; moulded depth, 30ft. 3in. Her cargo capacity is about 6500 tons deadweight, and upwards of 8000 tons measurement. The engines, which were all fitted on board before launching, are of the triple-expansion type, to work with forced blast, and indicate about 2000 horse-power; the diameters of cylinders being 26in., 41in., 67in., and 48in. stroke.

The large twin-screw cargo and passenger steamer, "H. H. Meier," was taken to sea for her trial trip on the 17th inst. This vessel, which has a capacity of about 7000 tons, has been constructed at the Walker shipyard of Messrs. Sir W. G. Armstrong, Mitchell and Co. The principal dimensions of the vessel are:—Length, 435ft.; breadth, 48ft.; depth, 32ft The triple-expansion engines have been supplied by Messrs. R. and W. Hawthorn, Leslie and Co., and have cylinders 24½in., 40in., and 66in. diameter, with a stroke of 45in. The valve gear is on Marshall's system. Steam at 160lb. is supplied from three large double-ended steel boilers, and in addition to this an auxiliary boiler at the same pressure is provided, which can be connected to the main engines in case of necessity.

Loss of Heat from Uncovered Pipes.

IT is well recognised that there is a material and important loss of heat, by radiation and otherwise, from long lines of unprotected steam pipe, yet many engineers, if asked how great this loss would be in any proposed case, would be unable to give any more than a rough guess at it. If the pipe is covered with some approved kind of non-conducting material, the loss may undoubtedly be greatly diminished; but pipe-covering costs money, and the owners of factories and mills naturally want to know, before investing in it, how much it will lessen their running expenses, and which of the many kinds of non-conductors will give the best satisfaction in the end. This problem is by no means easy to solve, yet it is coming up all the time, and we propose to present a few general facts that may make a serviceable foundation to base estimates upon.

In the first place we shall have to look into the phenomena of cooling, somewhat. We shall find that, however simple it may look at first sight, the problem presented by the steam pipe resembles a great many other heat problems in its deceptive complexity. A hot steam pipe, for example, is radiating heat constantly off into space, but at the same time it is cooling also by convection. By convection we mean that the air in contact with the pipe becomes heated, grows lighter, and flows upward, giving way to a fresh supply of colder air, which then acts in the same way. A good illustration of simple radiation is afforded by the open-grate fire used for heating dwellings. Nearly all of the air that is warmed by direct contact with the fuel passes up the chimney, and the only part of the heat that is available for heating the room is that which is radiated directly. Most of the heat felt by the crowds who delight to gaze on burning buildings is also purely radiant, for the air that is heated by direct contact with the building is free to rise high over their heads, its course being indicated by the sparks and smoke. On the other hand, the heat poured into a room warmed by the "indirect" system is entirely convective.

In addition to the problems presented by radiation and convection, the conducting power of the pipe comes up for consideration, for it is the temperature of the outside of the pipe that determines how much heat will be lost by radiation and convection, and unless the pipe is an absolutely perfect conductor the outside will be cooler than the inside by an amount that depends on a good many things, and is not easy to calculate. In all practical work, however, it may be assumed that the conducting power of ordinary steam pipe is great enough to keep the temperature of the outside pretty nearly up to that of the inside, so that for most purposes we can consider these two temperatures equal.

When we come to look for experimental data on which to base calculations of the heat radiated and otherwise lost by steam pipes, we find that they are neither numerous nor satisfactory. Box gives a number of results for the amount of heat radiated by different substances when the temperature of the air is 1° F. lower than the temperature of a radiating body. A portion of this table is given below. It is said to be based on Péclet's experiments.

HEAT UNITS RADIATED PER HOUR PER SQUARE FOOT OF SURFACE, FOR 1° F. EXCESS IN TEMPERATURE.

Copper, polished	0·0327
Tin, polished	0·0440
Zinc and brass, polished	0·0491
Tinned iron, polished	0·0858
Sheet iron, polished	0·0920
Sheet lead	0·1329
Sheet iron, ordinary	0·5662
Glass	0·5948
Cast iron, new	0·6480
Common steam pipe, inferred	0·6400
Cast iron and sheet iron, rusted	0·6868
Wood, building stone and brick	0·7358

When the temperature of the air is about 50° or 60° F., and the radiating body is not more than about 30° hotter than the air, we may calculate the radiation of a given surface by assuming the amount of heat given off by it to be proportional to the difference in temperature between the radiating body and the air. This is "Newton's law of cooling." But when the difference in temperature is great, Newton's law does not hold good; the radiation is no longer proportional to the difference in temperature, but must be calculated by a complex formula established experimentally by Dulong and Petit. Box has computed a table from this formula, which greatly facilitates its application, and we cannot do better than follow his lead:—

The use of this table will be made plain by the following illustration. Example: How many heat units will be radiated in one hour by an iron pipe, 10ft. long and 2½in. in external diameter, carrying steam at a temperature of 355° F., the air and

surrounding objects being at 32° F. ? Ans.: The circumference of this pipe is $2\frac{1}{2} \times 3{\cdot}1416 = 7{\cdot}363$in. $= 0{\cdot}614$ft. Hence, the area of its surface is $10 \times 0{\cdot}614 = 6{\cdot}14$ sq. ft. We see by Table No. 1 that one square foot of such a pipe will radiate about 0·64 of a heat unit per hour for one degree difference in temperature. Hence, the proposed piece of pipe will radiate $6{\cdot}14 \times 0{\cdot}64 = 3{\cdot}93$ heat units per hour for one degree difference in temperature, the real difference in temperature being 355°—32° = 323°. Newton's law gives us $3{\cdot}93 \times 323 = 1269$ heat units as the amount of heat radiated by the pipe in one hour. But Newton's law is not accurate for any such range of temperature, and we have to look at Table No. 2 for the proper correction factor to reduce this result into conformity with Dulong's law of radiation. The temperature of the air being 32°, we look in the column headed 32°, and opposite 324° we find the factor 2·07. Then, multiplying our previous result by this, we have $1269 \times 2{\cdot}07 = 2627$, which is the number of heat units the pipe may be expected to lose in one hour by radiation alone.

Differences in Temperature between Radiating Body and the Air—Fahr.	Temperature of Air—Fahr.						
	32	50	59	68	86	104	122
18	1·00	1·07	1·12	1·16	1·25	1·36	1·47
36	1·03	1·08	1·16	1·21	1·30	1·40	1·52
54	1·07	1·16	1·20	1·25	1·35	1·45	1·58
72	1·12	1·20	1·25	1·30	1·40	1·52	1·64
90	1·16	1·25	1·31	1·36	1·46	1·58	1·71
108	1·21	1·31	1·36	1·42	1·52	1·65	1·78
1 6	1·25	1·36	1·42	1·48	1 59	1·72	1·86
144	1·32	1·42	1·48	1 54	1·65	1·79	1·94
162	1·37	1 48	1·54	1·60	1·73	1·86	2·02
180	1·44	1·55	1·61	1·68	1·81	1·95	2·11
198	1·50	1·62	1·69	1·75	1·89	2·04	2·21
216	1·58	1·69	1·76	1·83	1·97	2·13	2·32
234	1·64	1·77	1·84	1·90	2·06	2·28	2 43
252	1·71	1·85	1·92	2·00	2·15	2·33	2·52
270	1·79	1·93	2·01	2 09	2·22	2 44	2·64
288	1 89	2·03	2·12	2·20	2·37	2·56	2·78
306	1·98	2·13	2·22	2·31	2·49	2·69	2·90
324	2·07	2·23	2·33	2·42	2 62	2·81	3·04
342	2·17	2 34	2·44	2·54	2·73	2·95	3·19
360	2·27	2·45	2·56	2·66	2·86	3·09	3·35
378	2·39	2·57	2·68	2·79	3·00	3·24	3·51

The loss of heat by convection appears to be independent of the nature of the surface; that is, it is the same for iron, stone, wood, and other materials. It is different for bodies of different shape, however, and varies with the position of the body. Thus, a vertical steam pipe will not lose so much heat by convection as a horizontal one will; for the air heated at the lower part of the vertical pipe will rise along the surface of the pipe, protecting it to some extent from the chilling action of the surrounding cooler air. It is for a similar reason that the shape of a body has an important influence on the result, those bodies losing most heat whose forms are such as to allow the cool air free access to every part of the surface. The following table from Box gives the number of heat units that horizontal cylinders or pipes lose by convection per square foot of surface per hour, for one degree difference in temperature between the pipe and the air:—

HEAT UNITS LOST BY CONVECTION FROM HORIZONTAL PIPES, PER SQUARE FOOT OF SURFACE PER HOUR, FOR A TEMPERATURE DIFFERENCE OF 1° FAHR.

External Diameter of Pipe in Inches.	Heat Units Lost.	External Diameter of Pipe in Inches.	Heat Units Lost.	External Diameter of Pipe in Inches.	Heat Units Lost.
2	0·728	7	0·509	18	0·455
3	0·626	8	0·498	24	0·447
4	0·574	9	0·489	36	0·438
5	0·544	10	0·482	48	0·434
6	0·523	12	0·472		

The loss of heat by convection is nearly proportional to the difference in temperature between the hot body and the air; but the experiments of Dulong and Péclet show that this is not exactly true, and we may here also conveniently resort to a table of factors for correcting the results obtained by simple proportion:—

Diff. in Tem. between Hot Body and Air—Fahr.	Factor.	Diff. in Tem. between Hot Body and Air—Fahr.	Factor.	Diff. in Tem. between Hot Body and Air—Fahr.	Factor.
18	0·94	180	1·62	342	1·87
36	1·11	198	1·65	360	1·90
54	1 22	216	1·68	378	1·92
72	1·30	234	1·72	396	1·94
90	1 37	252	1·74	414	1·96
108	1·43	270	1·77	432	1·98
126	1·49	288	1·80	450	2·00
144	1·53	306	1·83	468	2·02
162	1·58	324	1·85		

The use of these tables may be illustrated by referring once more to the example in radiation already given. To find the amount of heat lost by convection by the same pipe we proceed as follows:—According to Table No. 3, a pipe 2in. in external diameter would lose 0·728 of a heat unit per square foot of surface per hour for a temperature difference of 1° F. The corresponding number for a pipe 3in. in external diameter is 0·626. Hence we infer that a pipe $2\frac{1}{2}$in. in outside diameter would lose about 0·693 heat units per square foot of surface per hour for one degree of temperature difference. (For the difference between 0·723 and 0 626 is 0·102, and $\frac{1}{3}$ of 0·102 is 0·035. Then $0{\cdot}728 - 0{\cdot}035 = 0{\cdot}693$.)

The area of the pipe has already been found to be 6·14 sq. ft. Hence $6{\cdot}14 \times 0\ 693 = 4{\cdot}26$ heat units per hour would be lost by convection by the whole pipe, if its temperature were 1° higher than that of the air. As a matter of fact, its temperature exceeds that of the air by 323°; hence the total loss per hour by convection would be $4{\cdot}26 \times 323 = 1378$ heat units if the convection loss were strictly proportional to the temperature difference. As it is not so, we must take the proper correction factor from Table 4 We find this factor to be 1·85; hence $1376 \times 1{\cdot}85 = 2546$, which is the number of heat units we may expect the pipe to lose in one hour by convection. Hence, finally, we have:—Total loss of heat = total radiation loss + total convection loss = $2627 \times 2546 = 5173$ heat units per hour.

As a final example of the calculation of the loss of heat by steam pipes, let us find the amount of heat lost in one hour by a naked steam pipe $2\frac{1}{2}$in. in external diameter and 1ft. long, conveying steam at a pressure of 55lb. by the gauge, the temperature of the air and surroundings being 80° F. The temperature of the pipe will be found to be about 302° F. We have already found the surface of such a piece of pipe to be 0·614 of a square foot. The calculation, then, is as follows:—

Temperature difference = 302° − 80° = 222°.

Radiation loss per hour by Newton's law $-0{\cdot}614$ (area) $\times 0{\cdot}64$ (see Table 1) $\times 222 = 87{\cdot}2$ heat units.

Same reduced to conform with Dulong's law of radiation $= 87{\cdot}2 \times 1{\cdot}93$ (see Table 2) = 173 heat units per hour.

Correction loss per hour (considered proportional to temperature difference) $= 0\ 614$ (area) $\times 0{\cdot}693$ (see Table 3) $\times 222 = 94\ 6$ heat units.

Same reduced to conform with Dulong's law of convection $= 94{\cdot}6 \times 1{\cdot}70$ (see Table 4) $= 160{\cdot}8$ heat units per hour.

Then the total loss of heat per hour = loss by radiation + loss by convection $= 173{\cdot}0 + 160{\cdot}8 = 333{\cdot}8$ heat units per hour.

It is not claimed that the results obtained by this method of calculation are strictly accurate. The experimental data are not sufficient to allow us to compute the heat loss from steam pipes with any great degree of refinement; yet it is believed that the results obtained as indicated above will be sufficiently near the truth for most purposes.—"The Locomotive."

Notices of New Books.

TOOTHED GEARING: A PRACTICAL HANDBOOK FOR OFFICES AND WORKSHOPS. By A FOREMAN PATTERNMAKER. London: Crosby Lockwood and Co., 1892.

THE subject of toothed gearing has engaged the attention of many writers at various times, and much discussion has taken place on the proper form of teeth for geared wheels, and the means of producing the best curves to work with the least amount of friction and noise. The proportions of the parts of wheels have been pretty well settled for a long time past, mainly from practical experience. Of late years there has been a sort of revival in favour of power transmission by toothed wheels, more especially in the Lancashire mills, which has led to improvements in the methods of construction, and a consequent greater efficiency in working. In view of these and other improvements, and the general increase of knowledge on the subject, the older books on wheel gearing necessarily lag very much behind present-day practice There has long been room for a well-written treatise on gearing, treating the subject from a practical point of view.

The work before us is an excellent attempt in this direction, and it will be found fairly complete and exhaustive. It is divided into eighteen chapters, and illustrated with 184 engravings.

The writer states in his preface that he has "been engaged in the construction of toothed gearing all his life, and having felt the want of such a book he has endeavoured to treat the subject from the standpoint of the workshop and drawing office."

The first chapter deals briefly with the principles underlying the construction of gearing generally, followed by chapters on the formation of tooth profiles, proportions of teeth, etc. In the latter reference is made to the variations which occur in practice, both as to profiles and proportions, and the writer maintains rightly that "there is no reason why this want of unanimity should exist, since a uniform system of gears is as easily attainable as a uniform system of screw threads."

We are afraid it is too much to expect that any such uniformity will be attained in practice. It is, however, a subject which might very well engage the attention of some of the prominent engineering institutions, when they have done airing the fads and fancies of their leading members.

The writer in this chapter gives evidently with approval—because, it is to be presumed, he has nothing else to offer—for the proportions of teeth, what he calls the "good old rule," in which the pitch is divided into 15 parts, and the thickness of tooth, length, clearance, etc., taken as so many parts. This rule was first given, we believe, in the "Engineer and Machinists' Drawing Book" over 40 years ago, and we have advanced somewhat since then. He adds also the proportions given by such authorities as Molesworth, Unwin, and Box. All these authorities give proportions which result in a tooth of too great a length. There is no good reason why a wheel having, say, a 4in. pitch should have the tooth 3in. long, when $2\frac{1}{2}$in. would do equally well. We admit that the proportions given are very general among wheel makers; but a length of tooth of from $\frac{6}{10}$ to $\frac{5}{8}$ of the pitch is quite long enough. It is stronger, and wears equally as well. While on this point, we may remark that the author, so far as we have noticed, makes no reference to the length of teeth for worm wheels. These are generally made shorter than for spur wheels. Where spur wheel teeth are made $\frac{3}{4}$ of the pitch, the corresponding worm wheel teeth would not be made more than $\frac{5}{8}$ of the pitch in length.

Chapter IV. is devoted to describing the methods of marking out tooth forms; then follow chapters on involute teeth, some special tooth forms, bevel wheels, and screw gears.

Chapter IX. deals with worm gear in a thoroughly practical way. There is probably no form of gear so misunderstood as worm gearing, and about which so many mistakes are made. The reader will find in this chapter much useful information put into a practical form. The author, we notice, does not make any reference to the limiting number of teeth for worm wheels; and this is a very important point to bear in mind. This form of gearing absorbs much power in friction, let it be ever so well made, especially if the loads are heavy. The number of teeth below a certain number very rapidly affects the efficiency of the wheel and worm. The number of teeth to be used in a worm wheel should never be less than 30 for satisfactory work. This chapter would have been enhanced in value if something had been said as to the efficiency of worm gear in transmitting power. The convenience of the combination leads often to its being used to great disadvantage. It is seldom that ordinary cast worm wheels have an efficiency exceeding 50 per cent. even when well worn, while many have an efficiency of not more than 20 per cent. From these considerations it will be seen how important it is that these wheels should be correctly set out and carefully made.

Chapter X. treats of helical wheels, and here the author writes with knowledge and success. The whole subject is discussed with great fulness, and the correct principles on which such wheels are based clearly set forth. Helical wheels, when properly made, are considerably stronger and run much quieter than ordinary gear wheels. But if badly made, they had better be left severely alone. It should always be borne in mind that a helical wheel is in principle a screw of the diameter of the wheel, having as many threads as there are teeth in the wheel. From this it will be evident that the face of the tooth is not a straight line, but partakes of the curve of a screw. In large wheels the face is nearly straight, and many makers say they are practically straight, and make them so, with the result that these wheels are the wheels to avoid.

Other chapters relate to skew bevels, variable and other gears, diametrical pitch, the odontograph, pattern gears, and machine-moulded wheels. In the latter chapter the author gives proportions for machine-moulded wheels with H arms, and a table for various pitches and diameters, which will be found useful. Some of the proportions, however, will not work very well. For example, the thickness of the arms marked E—those in the plane of the wheel motion—is given as $\frac{1}{8}$ of W = width of wheel face. A wheel having teeth $1\frac{3}{4}$in. pitch and $4\frac{1}{2}$in. face would, with the author's proportions, be $\frac{4\frac{1}{2}}{8} = 0{\cdot}56$, or, say, $\frac{9}{16}$in. only. They would be made not less than $\frac{5}{8}$in. thick by most firms. Take a wheel $4\frac{1}{2}$in. pitch, 13in. face. $E = \frac{13}{8} = 1\frac{5}{8}$ say. They would probably be made $1\frac{3}{4}$in. or 2in. thick. The proportions for the thickness of the nave also gives too great a thickness for heavy wheels. The proportions for the width of the nave, say $G = W + 0{\cdot}12D'$, must be wrong. We presume it should read $G = W + 0{\cdot}012D'$.

Take the wheel given above, $4\frac{1}{2}$in. pitch, 13in. face, 9ft. diameter. G according to the rule $= 13 + 0{\cdot}12D = 13 + 12{\cdot}96 = 25{\cdot}96$in., manifestly an absurd result. The actual width would be about 17in. We should like to have seen a chapter devoted to the building up of large spur wheels, the method of fixing the arms to the boss, and fitting the segments together; also examples of the many different sections of arms employed.

On the power of wheels the author is satisfied with quoting the rules of various authorities, none of which are very satisfactory. In future editions of the work this part of the subject could be amplified with advantage.

We had expected also, in a work of this character, some reference made to the practice of several firms in machine cutting the teeth of large spur driving wheels, which has lately been followed with good results.

A useful addition to the book would have been a table of weights for wheels of various diameters and pitches. It would have proved useful to those who have occasion to estimate for work requiring wheels which have to be ordered from other makers.

Although we have pointed out a few omissions in the book, we must give it our unqualified praise for the thoroughness of treatment throughout, and we can heartily recommend it to all interested as the most practical book on the subject yet written.

Trade Notes.

The Small Arms Company, Vienna, have received an order for 300,000 rifles from the Roumanian Government.

Messrs. Patterson and Cooper, of Westminster, London, are fitting up an electric-lighting installation at the Corporation Markets at Hull.

The premises of the Singer Manufacturing Company in Dundee are being fitted with an installation of electric light by Messrs. A. MacLeod and Co., of Glasgow.

Messrs. Mather and Platt Limited, Salford, have been awarded four gold medals at the Kimberley Exhibition for exhibits of electric-lighting and power plant.

The tender of Messrs. Appleton, Burbey and Williamson, of London, at £5074, for the electric fittings at Claybury Asylum, has been accepted by the London County Council.

Messrs. Brown, Marshalls and Co., railway rolling stock builders, Birmingham, have decided to recommend a half-year's interim dividend at the rate of 10 per cent. per annum.

Messrs. D. Rowan and Sons, Glasgow, have contracted to supply the engines and necessary machinery required for a twin-screw steamer to be built by Messrs. Murdoch and Murray, of Port Glasgow.

Messrs. David J. Dunlop and Co., Inch Works, Port-Glasgow, have just concluded a contract with the Anglo-American Oil Company Limited, to build and engine another large steamer for the carriage of oil in bulk between America and this country.

Messrs. John Abbot and Co., Newcastle-on-Tyne, have received a large order from the Hull Gas Company for columns, girders, etc., for use in connection with the erection of new retorts. This firm has also received from the Southampton Dock Company an order for hydraulic machinery.

The directors of Messrs. Crompton and Co. Limited, electrical engineers, London, have declared interim dividends for the six months ending September 30 last, at the rate of 7 per cent. per annum on the preference shares of the company, and at the rate of 5 per cent. per annum on the ordinary shares.

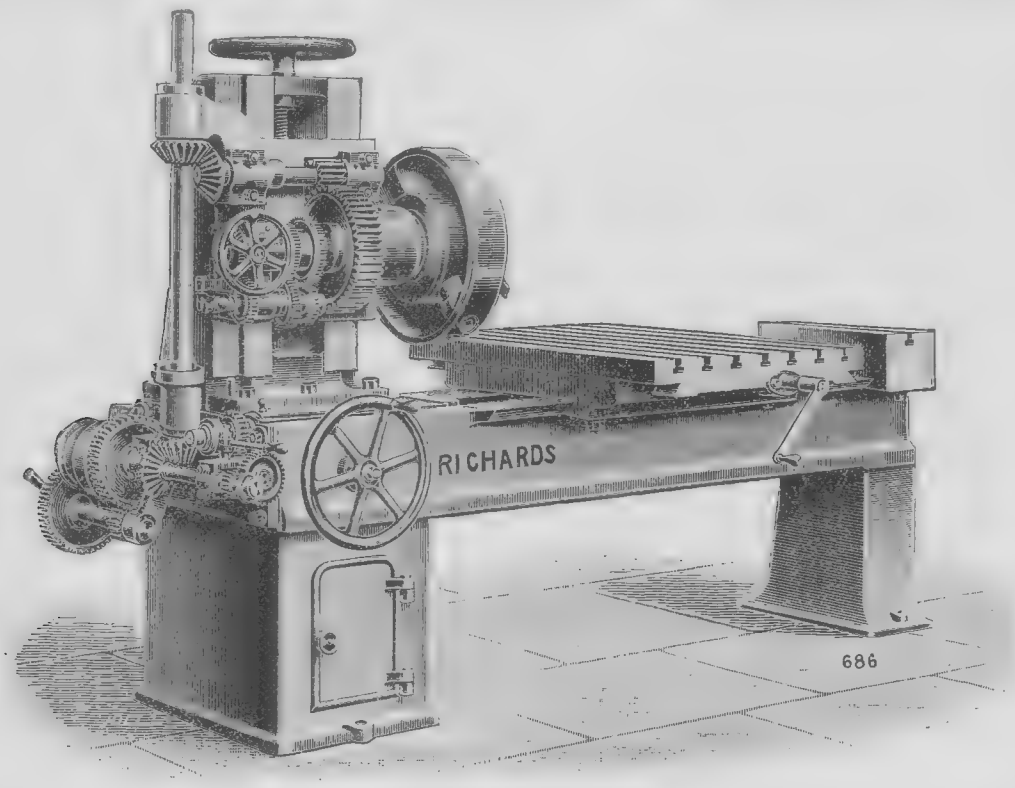
Readers of "The Mechanical World" are invited to send to the publisher of "Good Health," the new weekly paper devoted to food, drink, medicine and sanitation, for a parcel of specimen copies, which will be sent gratis and post free, for distribution among their friends at home and abroad. Address, 391, Strand, London, or New Bridge-street, Manchester.

Wheel cutter in metal only. Every description of gearing. R. CHIDLAW, 43, City-road. Manchester.

Having regard to the enormous circulation of THE MECHANICAL WORLD, the Editor suggests that it is by far the best medium for the insertion of every kind of "Wanted" advertisement, and the price is only one halfpenny per word. The Editor will be glad if MECHANICAL WORLD readers will kindly bear this in mind as occasion arises.

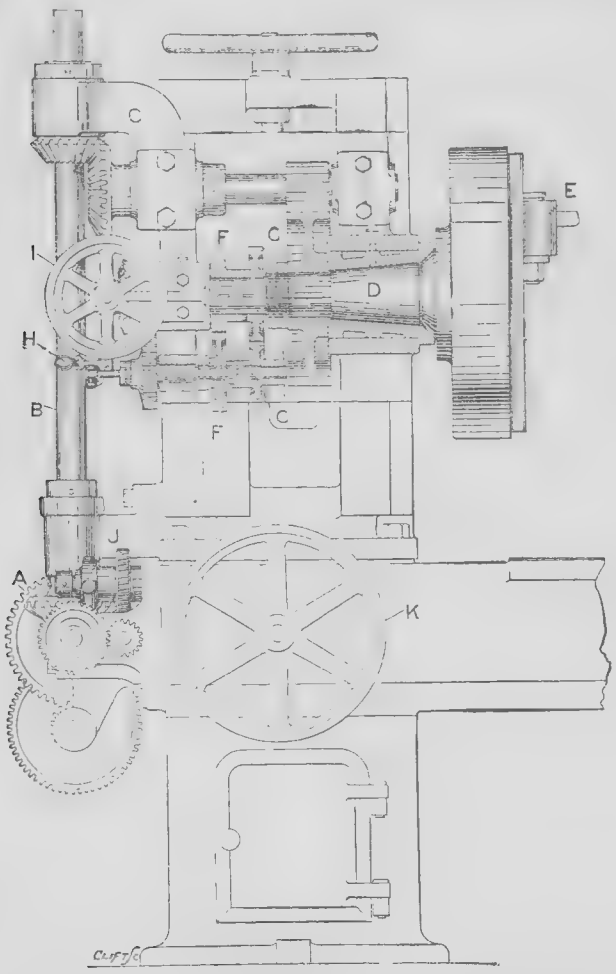
Pearn's Patent Pipe-facing Machine.

We have much pleasure in directing attention to a new and exceedingly useful machine for facing and turning the edges of flanged pipes, elbows, bends and tees, and for facing and boring seats for valves, etc. We recently saw the machine in operation at the works of the inventors, Messrs. Frank Pearn and Co., Gorton, Manchester; and the results obtained were certainly most surprising. Some idea of the utility of the machine will be obtained when we say that it is now doing the work which formerly occupied two planing machines and one 12in. lathe. We need scarcely remark that this not only represents a considerable saving of wages, but also economises shop room and capital to a very appreciable extent.



Pipe-facing Machine.—Fig. 1.

The machine is fully shown in the accompanying illustrations, of which Fig. 1 is a general view and Fig. 2 a sectional elevation. At first sight the machine appears to somewhat resembles a boring machine, but reference to Fig. 2 will show that the construction is considerably different. The spindle carrying the facing head is of great strength, being 4¼in. diameter at the front end and 3¼in. diameter at the back bearing. It is ground to fit the bearings, which are of phosphor bronze, the front one being designed with a special view of reducing to the minimum the friction caused by taking heavy facing cuts; and, as will be seen, ample wearing surface has been allowed. The tool slide is actuated by a screw 1½in. diameter, and is made extra long so as to ensure freedom from jar. A swivel toolpost is fitted to the slide, and will receive a tool with 1½in. square shank, and is so arranged that, no matter how heavy the cut, it is impossible for it to move. The feed mechanism is an important feature in this machine. While being quite continuous, it is arranged so that when the pipe is fixed on the table, by moving a lever H (Fig. 2) in one direction, the inward or "roughing" feed is given. When this is finished, the reversal of the lever engages the outward or "finishing" feed, which has twice the speed of the roughing-out feed. By throwing the lever into its central position, and engaging the lower lever J (Fig. 2) the table is fed forward, thus enabling the tool to turn the edge of the flange. We may point out that there is no change of tool, as one ground to the correct shape will perform all these operations. The usual arrangement of the head is shown in Fig. 4, which is in this form capable of facing and edging flanges up to 15in. diameter; but by using the extension toolholder as shown in Fig. 3, a diameter of 22in. can be faced. The table is 3ft. 6in. long, 2ft. 6in. wide, and has a hand cross adjustment of 3ft. It is moved longitudinally on the bed either by the hand-wheel K (Fig. 2), or automatically for edging or boring, by means of a worm and wheel, which is thrown into gear by means of the lever J (Fig. 2). In Fig. 5 the machine is diagrammatically shown arranged for facing pipe flanges, while in Fig. 6 the use of the tool as a boring machine is indicated, a stay which may be adjusted in height to suit the position of the head being provided as shown. In Figs. 5 and 6 the samples of work are shown fixed to a revolving table. This latter is, in our opinion, a very important feature of the machine, as it enables work to be faced on four sides if desired, each of which will be accurately at right angles to each other when finished. It is clear that by extending this principle, and providing a sufficient number of stops, the accurate facing of polygonal objects may be readily accomplished.



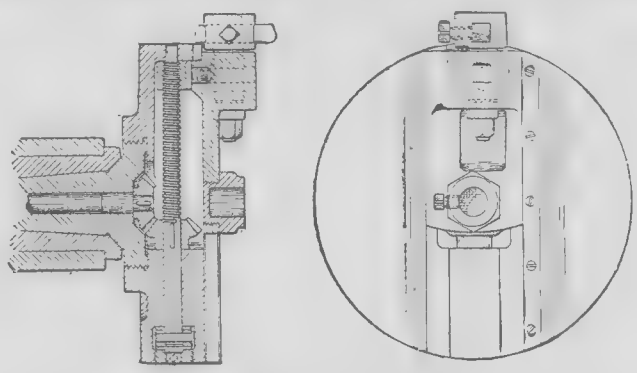
Pipe-facing Machine.—Fig. 2.

From Fig. 1 it will be seen that the machine is driven through an ordinary back-geared headstock, which actuates the bevel gears A (Fig. 2), and through the shaft B and gearing C, to the spindle D.

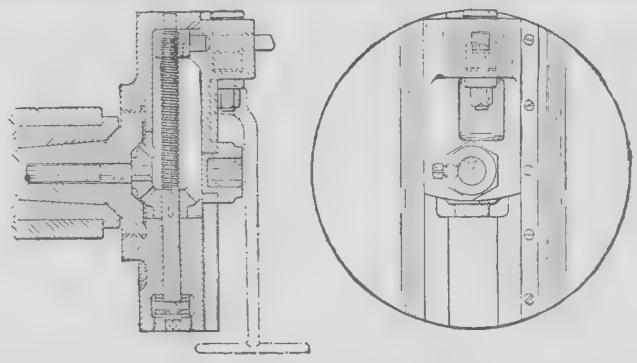
The tool E is fed by the wheels F and G, which are thrown in or out of gear by an internal clutch worked by the lever H. The pair of gears F give the inward or roughing feed, while G gives the broad outward feed for finishing. The headstock is fitted with a four-speed cone, and is provided with treble back gear, thus giving twelve changes of speed, which are ample for working from 22in. diameter down to zero. The treble gearing is geared respectively 5 to 1, 14 to 1, and 42 to 1, and the belt is 3in. wide. When working on the largest diameter cone, it will be seen that very heavy cuts can be taken. The headstock has a vertical adjustment of 12in., and in its highest position is 18in. above the top of the table. The total floor space occupied by the machine is 8ft. 6in. by 7ft.

Fig. 7 represents the machine being used for boring small fly-wheels or pulleys. In this case the revolving table is removed and a slide rest fixed in its place, rendering the tool in every respect equal to a pulley-boring and turning lathe.

It will be evident that the machine when used for its special purpose is an enormous advance upon the planing-machine method of facing flanges. The advantage of obtaining continuous cutting is of great moment, as not only is the immense waste of time occupied in performing the back stroke in the planer completely obviated, but the impact upon the tool at each succeeding cut is avoided, and this renders a higher cutting speed possible. The machine has been in operation at Messrs. Pearn's works for over twelve months, and has proved a thorough success in every way. We may add that this useful tool is made by Messrs. George Richards and Co. Limited, Broadheath, near Manchester, whose reputation for high-class machine tools is a sufficient guarantee of the excellence of the workmanship. We are convinced that the machine has an important future, and when once its capabilities are fully appreciated it will doubtless find a worthy place in every machine shop of repute.



Pipe-facing Machine.—Fig. 3.



Pipe-facing Machine,—Fig. 4.

Electro-metallurgy.*

One of the wonderful things about the electro-deposition of copper, and, in fact, any other metal deposited from a solution of its salt in water, is, that bright, hard, solid metal, such as we are accustomed to see produced by means of fusion, can, by the action of the electric current, be made to separate from a liquid which has no appearance of metal about it.

The beginning of every electro-deposition process is the making of a solution of the metal to be deposited. I am going to dissolve a piece of copper, the most elementary of all chemical operations; but I want to make it quite clear where the metal to be deposited comes from—to show that it is actually in the solution, and actually comes out of it again; for that is an effect

* Abstract of a lecture by J. Wilson Swan, delivered before the Royal Institution of Great Britain.

so surprising that it requires both imagination and demonstration to make it evident. There is a glass cell containing nitric acid. In this I will put a piece of copper; it quickly disappears, and a blue solution of copper nitrate is formed. Now, if I pass an electric current through this solution, or through some solution of the same kind, and immerse in it, a little apart from each other, the positive and negative wires coming from some generator of electric current, this will happen: Metallic copper will come out of the solution and attach itself as a coating to the negative wire, and consequently that wire will grow in thickness. At the other wire—the positive—exactly the reverse action will take place. There, if the positive wire be copper, it will gradually dissolve and become thinner. The quantity of metal deposited on the negative wire will almost exactly equal the quantity dissolved from the positive, and therefore the solution will contain the same quantity of metal at the end of the experiment as at first, but it will not be the same metal; it will be fresh metal dissolved from the positive wire, and the metal originally contained in the solution will have been deposited as metallic copper.

For the reproduction of fine works of art in metal, electrotype is unapproachable. The extreme minuteness with which every touch of graver or modelling tool is copied by the deposited metal film, separates electrotype by a wide space from all other modes of casting. Even the Daguerreotype image is not too exquisitely fine for electrotype to copy it so perfectly that the picture is almost as vivid in the cast as in the original.

It is this quality that has given to electrotype a *rôle* which no other process can fill, and so far its practical utility is not greatly dependent on the cost of the current.

One of the uses of electrotype, not greatly affected by the cost of deposition, is that of the multiplication of printing surfaces. In these days of illustrated periodicals, electrotype has come more and more into use for making duplicate blocks from wood engravings, which would soon be worn out and useless if printed from direct. It is also employed to make casts from set-up type, to be used instead of ordinary stereotype casts, when long numbers of a book have to be printed; also as a means of copying engraved copper plates.

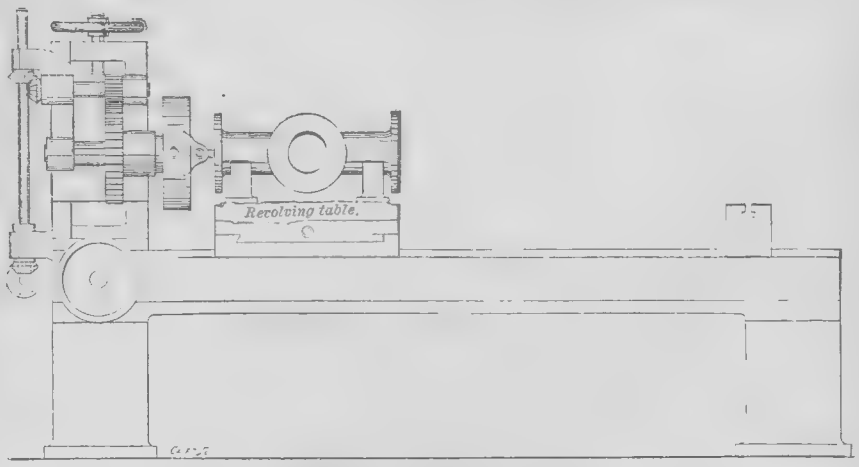
The plates illustrate the method employed at Southampton in the map printing department. The original plates are not printed from, except to take proofs. The published maps are all printed from electrotypes. Here is an original plate—here the matrix, or first electro, with, of course, all the lines raised, which are sunk in the original. The second electro is, like the original, an intaglio. Here is a print from it, and here one from the original plate. Practically they are indistinguishable from each other, and bear eloquent testimony to the wonderful power of electrotype to transmit an exceedingly faithful copy of such a surface.

Nickel has of late years come into extensive use for what is termed nickel-plating, as applied to coating polished steel and brass with nickel. Nickel not only has the advantage over silver of cheapness, but also, in some circumstances, of greater resistance to the action of the air.

Another metal usually deposited in the form of a coating is iron. The electrolytic deposit of iron is peculiarly hard—so much so that it is commonly, but erroneously, spoken of as *steel-facing*. The deposition of a film of iron upon engraved copper plates, as a means of preventing the wear incidental to their use in being printed from, has become almost universal. Valuable etchings, mezzotints, and photogravure plates are thus made to bear a thousand or more impressions without injury. By dissolving off the iron veil with weak acid, when the first signs of wear appear on the surface of the plate, and recoating it with iron, an engraved copper plate is, for all practical purposes, everlasting.

In this case, of course, the film of iron is extremely thin—one or two hundred thousandths of an inch. But it is possible to produce most of the metals commonly used as coatings in a more massive form. Here, for example, is an iron rod ¼in. in diameter, entirely formed by electrolytic deposition. I am indebted to Mr. Roberts-Austen for being able to show this, and also for this other example of a solid deposit of iron, and for this beautiful specimen of electolytic coating with iron. Here, also, are solid deposits of silver. This drinking cup is a solid silver electro-deposit.

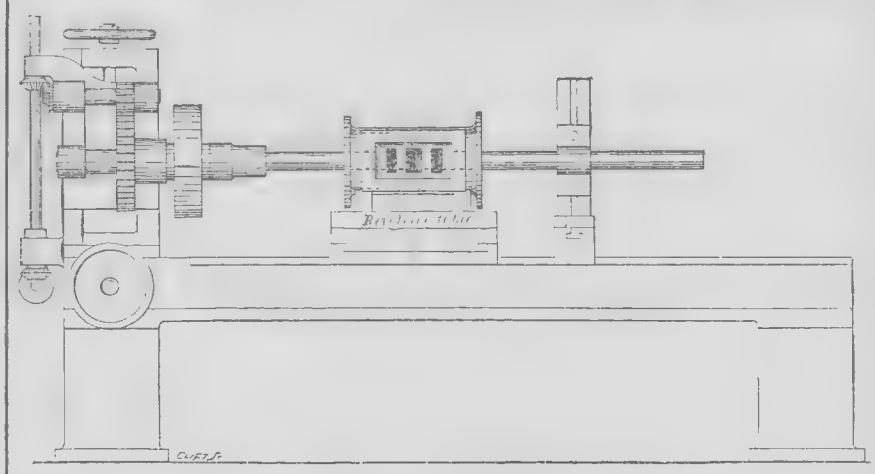
These are all departments of electro-metallurgy which would have maintained a perfectly healthy industrial existence and growth without the dynamo; but now I come to speak of a branch of the subject—electrolytic copper refining—which, without that source of cheap electricity, could not have existed. This is the most extensive of all the applications of electro-chemistry, and is rendering valuable assistance to electrical engineering by the improvement it has led to in the conductivity of copper wire.



Pipe-facing Machine.—Fig. 5.

One of the results of this is seen in the raising of the commercial standard of electrical conductivity.

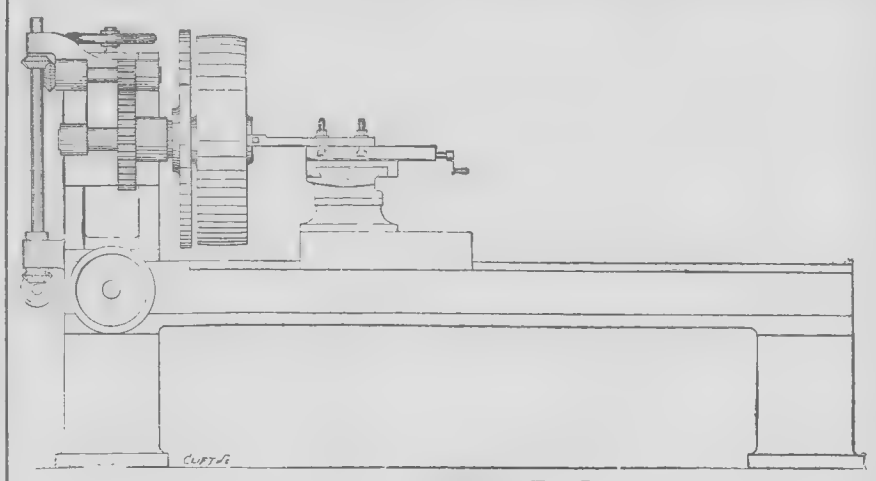
Ten years ago, contracts for copper wire for telegraphy stipulated for a minimum conductivity of 95 per cent. of Matthiessen's standard of pure copper. Now, chiefly owing to electrolytic refining, a conductivity of 100 per cent. is demanded by the buyer and conceded by the manufacturer.



Pipe-facing Machine.—Fig. 6.

The result of experiment shows that the copper of the 1858 Atlantic cable was extremely bad as a conductor, that in fact it was 150 per cent. worse than the best commercial copper of to-day. In other words, it shows that, in point of electrical conductivity, one ton of the copper of to-day will go as far as 2½ tons of such copper as was used for the cable of '58.

This change is largely due to electrolytic copper refining.



Pipe-facing Machine.—Fig. 7.

To prepare the crude copper for the refining process it is cast into slabs; these form the anodes. The cathodes are formed of thin plates of pure copper. In copper refining works, an immense number of plates, each having 6 to 10 square feet of superficial area, are operated upon together in a great number of large wooden vats containing sulphate of copper solution and a small proportion of sulphuric acid. Electric current from a dynamo, driven by a steam engine or water power, is conveyed by massive copper conductors to the vats, arranged in long lines of 50 or 100 or more in series. Thick copper bars connect adjoining vats, and provide a positive and negative support for the plates, which hang in the solution, opposite each other, two or three inches apart. During the process the impure slabs dissolve, and at the same time pure copper is deposited from the solution upon the thin plates. The deposition and dissolving go on slowly, in some cases very slowly, for a slow action takes less power and gives purer copper than a more rapid one. The usual rate is from 1 to 10 ampères per square foot of cathode surface.

You will better realise what these rates of deposit mean when I say that one ampère per square foot rate of deposition gives for each foot of cathode surface nearly 1oz. of copper in 24 hours, and a thickness of $\frac{1}{800}$in.; and therefore the production of one ton of copper at that rate, in 24 hours, would require a cathode surface in the vats, in round numbers, of 36,000sq. ft. At the higher rate of 10 ampères per square foot, which is used where coal is cheap, $\frac{1}{10}$ of this area would be required.

The importance of the electrolytic copper-refining industry, and the extent of the plant connected with it, may be inferred from the fact that, reckoning the united production of all the electrolytic copper works in the world, nearly one ton of copper is deposited every quarter of an hour.

Very little power is required for copper deposition if the extent of the dissolving and depositing surfaces is large relatively to the quantity of copper deposited in a given time.

Some of the impurities ordinarily found in crude copper are valuable. Silver and gold are common impurities, and these and some other impurities do not enter into solution, but fall down as black mud, are recovered, and go to diminish the cost of the process or increase the profit; and even those impurities which enter into solution are, under ordinary conditions, almost completely separated.

Electrolytic copper refining is both an economical and an effective process. The deposited copper is exceptionally pure. At one time it was supposed that it must necessarily be quite pure, but this is not the case; other metals can be deposited with the copper, but it is not difficult to realise in practice a close approximation to absolute purity in the deposited copper. Here is an example of the deposition of a mixed metal—brass—that is, copper and zinc deposited together. These deposits of brass and other alloys show that more than one metal can be deposited at the same time. The great enemy to conductivity in copper is arsenic, and the deposition of arsenic as well as copper is one of the things to be guarded against in electrolytic copper refining. Not only are the chemical characteristics of electrolytically-refined copper generally good, but its mechanical properties are largely controllable. Usually electrolytic copper is melted down and cast into billets of the form required for rolling and wire-drawing. This treatment not only involves cost, but the copper is apt to imbibe impurity during fusion, though if the process is carefully conducted the deterioration is slight.

But it is evident that the remelting of the deposited copper is a thing to be avoided, if possible, and the question naturally arises, Why, now that deposition costs so little, may not the beautiful principle which comes into play in electrotype, and which enables the most complicated forms to be faithfully copied, be taken advantage of to give to plainer and heavier objects their ultimate form?

There are several reasons why this idea is not more frequently acted upon. One is, that the process of electrolytic deposition is slow; another, that knowledge of the conditions necessary for obtaining a deposit having the required strength and other qualities is not very widespread. Moreover, in the electrolytic deposition of copper, and indeed of all metals, there is a strong tendency to roughness on the outside of the deposit, and to excrescent growths, the removal of which involves waste of labour and material. These tendencies can, to a very great extent, be counteracted by careful manipulation and the use of suitable solutions, and they can also be counteracted by mechanical means. This has been done by Mr. Elmore. He remedies the faults I have mentioned by causing a burnisher of agate (arranged after the manner of a tool in a screw-cutting lathe) to press upon and traverse a revolving cylindrical surface on which the deposit is taking place, and while it is immersed in the copper solution. The result is that it is kept smooth and bright to the end of the process.

But the use of the burnisher is not the only means available for the production of a smooth deposit. It was observed in the early days of electro-plating how great a change was effected in the character of the metal deposited by the presence of a very small quantity of certain impurities. It was found, for example, that an exceedingly mild dose of bisulphide of carbon, if put into a bath from which silver was being deposited, caused the deposit to change from dull to bright.

I have lately had experience of a similar kind with nickel and with copper. I was working with a hot solution of nickel, and up to a certain point the deposit had the usual dead-grey appearance. Suddenly, and without doing anything more than putting in a new cathode. I found the character of the deposit completely changed. Instead of the grey, tough, adherent deposit, there was produced a brittle, specular deposit, which scaled off in brilliantly shining flakes of metal. I sought for the cause of this extraordinary change, and traced it to the accidental introduction into the solution of a minute quantity of glue.

By adding gelatine to a fresh nickel solution I obtained the same peculiar bright and brittle deposit that had resulted from the accident. I then made a similar addition to a solution of copper, and when I hit the right quantity—an exceedingly minute one,—bright copper, instead of dull or crystalline, was deposited. Here are some specimens. They were deposited on a bright surface, and they are bright on both sides.

Not only is the copper made bright under the conditions I have described, but if the proportion of the gelatine be carried to the utmost that is consistent with the production of a bright deposit, it becomes

exceedingly hard and brittle. Beyond this point the deposit is partly bright and partly dead, the arrangement of the patches of dead and bright being in some cases very peculiar, and suggestive of a strong conflict of opposing forces.

Before I leave the subject of copper deposition, I may mention that I have found the range of current density within which it is possible to obtain a deposit of reguline metal far wider than is commonly supposed.

The rate of deposition in copper refining is usually very slow, and it is one of the drawbacks of the process, since slow deposition necessitates large plant. But rapid deposition necessitates a larger consumption of power, and larger cost on that account, and, therefore, there is a point beyond which it is not good economy to go in the direction of more rapid deposition. Still there are cases where, if we had the power to deposit more rapidly, it might be found useful to exercise it. The subject of more rapid deposition is also interesting from a scientific point of view; I therefore mention an unusual result I have arrived at in this direction.

Taking as one extreme the slow rate of deposit of one ampère per square foot of cathode—a rate not infrequent in copper refining,—I have found that the limit in the other direction is not reached by a rate of deposit 1000 times faster. I have produced, and I hope to be able to produce before you, a perfectly good deposit of copper with a current density of 1000 ampères per square foot of cathode.

This cell contains a solution of copper nitrate with a small proportion of ammonium chloride. The plate on which I am going to produce a deposit of copper has an exposed surface of 2 sq. in. Opposite, at a distance of 1 in., is a plate of copper. When I close the circuit a current of 140 ampères is passing through the solution. I continue this for just one minute. Now I wash it and remove the outer edge so as to detach the deposit, and as you see, I have a sheet of good copper—an electrotype.

To have produced a deposit of this thickness at the ordinary rate used in electrotyping operations would have occupied more than an hour.

In this experiment an extreme degree of rapidity of deposition has been shown. I do not intend to suggest such a rate as of practical value. But it is at least interesting, as showing that the characteristic properties of copper are not less perfectly developed when the atoms of metal have been piled up one on the other at this extremely rapid rate than when there is slower aggregation.

I think it probable that a rate of deposit intermediate between this rate and the usual one of about 10 ampères per square foot may frequently be useful, for no doubt the slowness of the rate of deposit often prevented electrotype from being made use of where, if the rate could have been increased ten times, it might have been employed with advantage.

Here are some thick plates, deposited at the rate of 100 ampères per square foot. They are as solid and as free from flaw as plates deposited ten times more slowly.

I said that electrolytic copper refining owed its existence to the discovery and improvement of the dynamo, and that other electro-metallurgic industries had originated from the same cause. One of these industries is the electrolytic production of aluminium.

When Deville produced aluminium by the action of sodium on aluminium chloride, exaggerated expectations were entertained of the great part it was about to play in metallurgy. It was very soon found that aluminium had not all the virtues that its too sanguine friends had claimed for it, but that it had a great many most valuable properties, and given a certain degree of cheapness a number of useful applications could be found for it. Some of these are suggested and shown by the various articles made of aluminium, kindly lent by the Metal Reduction Syndicate, and metallurgical research is rapidly extending our knowledge of its importance in connection with the improvement of steel castings and the production of bronzes and other alloys of extraordinary strength. The cost of the aluminium produced by Deville's process was too great to permit of its use on any large scale for these purposes.

After Davy demonstrated, by the electrolytic extraction of potassium and sodium, the power of the electric current to break down the strong combination existing between the alkaline metals and oxygen, it seemed natural to expect that aluminium would also be reduced by the same means. But Davy did not succeed in producing any appreciable quantity of aluminium by the electrolytic method. Deville and Bunsen were more successful, but they did not possess the modern dynamo; that has made all the difference between the small experimental results they achieved and the industrial production of to-day, a production now so large that I suppose every day it amounts to at least one ton, and has resulted in a very great reduction in the price of the metal.

There are two electrolytic processes at work. One is the Hall process—employed at Pittsburg and at Patricroft, Manchester, and now in experimental operation here. The other, the Herault process, worked at Neuhausen, is not greatly different from the Hall process. The shape of the furnace or crucible is different, and the composition of the bath yielding the aluminium may be different, but in all essentials these two processes are one and the same. They depend on the electrolysis of a fused bath, composed of cryolite, aluminium fluoride, fluorspar, and alumina. In the Hall process this mixture is contained in a carbon-lined iron crucible—the cathode in an electric circuit, and between which and the anode—a stick of carbon immersed in the fused bath—a difference of potential of 10 volts is maintained. In carrying out the process on a manufacturing scale, there are many of these sticks of carbon to each bath. Here, in our experimental furnace, there is only one.

The heat developed by the passing of so large a current as we are using (180 ampères), through an electrolyte of but a few inches area in cross section, is sufficient to melt and keep red hot the fluorides in which the alumina is dissolved.

The electrolytic action results in the separation of aluminium from oxygen. The metal settles to the bottom of the pot, and is tapped or ladled out from time to time, as it accumulates. The oxygen goes to the carbon cylinder, and burns it away at about the same rate as that at which aluminium is produced. It is only necessary to keep up the supply of alumina to enable the operation to be continued for a long time. I mean, of course, in addition to the keeping up of the current and the supply of carbon at the anode.

By far the greater part of the cost of aluminium obtained by electrolysis is the cost of motive power—20 H.P. hours are expended to produce 1 lb. of aluminium. Therefore it is essential for the cheap production of aluminium to have cheap motive power.

There is one feature about the Neuhausen production of aluminium which is very striking, and that is the generation of the electric current by means of water power derived from a portion of the Falls of the Rhine at Schaffhausen.

The motive for making use of water power is economy. But apart from that it is interesting to see water replacing coal, not only in the production of power, but also in the production of the heat required in a smelting furnace.

The Resistance of Railway Curves.

[CONTRIBUTED.]

THE leading article of "Engineering" of September 23 deals with the results of some experiments made in France on the resistance of railway curves.

The experiments named have a certain amount of interest to engineers, but will hardly lead to the advancement of anything practical, and they may seriously mislead if the inferences drawn from them be accepted without full examination.

The inference that "superelevation (of outer rails of curves) may become a cause of instability by favouring displacement of axles towards the inner rails," need hardly have been brought under a child's notice, though perhaps, and in connection with the experiments, it was unavoidable not to state it; but the whole tendency of the tabulation of results and of the inferences together is mischievous, as it leads, on the face of it, to the idea that superelevation may be discontinued.

Now, in the case of locomotives, or of other wheeled weights passing round curves, there is one great ruling element to be allowed for, and that is the side thrust on the outer rail caused by the tendency of the moving weight to maintain a straight path, or, otherwise, caused by the rail diverting the path of the weight to a curved one.

This side pressure (to avoid a lengthy disquisition) we shall call centrifugal pressure, and we shall find that its main effects are to push outer rails aside, and equally to put a pressure on the flange of a wheel; its minor effects are to give a climbing power to the side of the flange of a wheel and a cutting or grinding power to the forward edge of the flange—to this latter effect, which is principally experienced on the foremost wheel carrying weight, we will give the name "steering" effect, as it is this operating on a curved rail which diverts a moving weight from a straight path.

The French experiments deal with but the two minor effects of curvilinear motion—with but the resistance a weight on wheels experiences to forward motion round a curve,—and as within a pretty wide range of inclination of the plane betwixt inner and outer rails the mere curve of the outer rails is almost entirely responsible for the diversion of the steering edge of a wheel flange, we may well expect that superelevation of outer rails goes for nothing.

That superelevation should thus come to be reckoned of little or no account is right enough when, as we have said, the minor effects of curvilinear motion alone are dealt with, and merely pressure tending to reduce speed of forward motion is under consideration—and a curve will act and will cause pressure and divergence whether superelevation is used or not; but if we were to jump at the conclusion that superelevation, therefore, may be disregarded and disused, very mischievous results would ensue.

Taking the friction of metal on metal of the climbing tendency of the flange of a wheel in motion, and of its steering pressure on a rail to be 10 per cent. of the load, then, with 20 per cent. of any load we need not much fear the derailment of any vehicles passing around curves having no superelevation so long as the rails might have sound edges. But allowing for centrifugal pressure, and knowing that at certain moderate speeds a weight, such as that of one of our locomotives, will develop a side thrust on an outer rail of many tons pressure, tending to displacement of the rail, and at the same time carrying a multiplied strain on an axle agreeable with the leverage of the radius of the wheel, on the radius of the axle we shall be unwilling to risk any of our present rolling stock over curves having no superelevation.

The exact superelevation necessary to counterbalance the centrifugal pressure of a weight constrained to move around a curve may be easily calculated, and then the inference deduced from the experiments on the minor effects on forward motion—viz., that "superelevation may become a cause of instability, etc."—will be easily perceived to be a very trite one, as when we consider that superelevation should be so as to suit the highest speed, whilst gen ral speeds are but low, and that thus weights run at the low speeds may—apart from the steering friction of their flanged wheels—have their weight to slide down the inclined plane of the superelevation so as to press on the inner rail of a curve.

But, because of the tangential tendency of a weight moving around a curve, and, still more, because of the friction of metal on metal, a very great superelevation of an outer rail would have to prevail before a sliding angle would be reached and pressure on an inner rail be experienced.

Yet superelevation may be made greater than the necessity of any case requires, and so, merely because we may make a wrong estimate of the amount of centrifugal pressure of any curvilinear motion, we may, in fact, estimate it at double that actually pertaining in nature.

(To be continued.)

Metal Trade Memoranda.

During the month of November Canada exported to Great Britain 2058 tons of copper ore, as compared with 692 tons in November, 1891.

The site of the South Stockton Ironworks, Thornaby-on-Tees, which are now being dismantled, will be occupied by the new gas works which the Stockton Corporation intend erecting for Thornaby.

It is reported that four of the five furnaces at present in blast at Langloan Ironworks, Airdrie, are being damped down. The stoppage is understood to be for alterations and repairs, and will extend over about four months.

A notice has been posted in the Clydesdale Iron and Steel Works, Mossend, owned by the Clydesdale Iron and Steel Company, intimating a reduction of 5 per cent. on the wages of all time men. Contracts with tonnage men will cease in fourteen days, dating from December 17.

Mr. Alexis Rader, of Christiania, Norway, recommends an alloy of the following composition as a solder for aluminium:—Cadmium, 50 per cent.; zinc, 20 per cent.; tin, 30 per cent. The zinc is first melted in any suitable vessel, and then the cadmium is added, and afterwards the tin in small pieces.

Some twenty years ago enormous quantities of very rich magnetite and hematite were discovered in South Australia, but the absence of any local coal made it impossible to utilise these very valuable deposits of iron ore. Since the discovery of coal in that province a year ago, attention has again been directed to these deposits, and the result is that a company has been formed to start mining the ore, and another company is erecting an iron and steel works at Port Victor. The magnetite gives the following analysis:—Protoxide of iron, 67·92 per cent.; peroxide of iron, 30·25 per cent.; alumina, 0·14 per cent.; magnesia, 0·61 per cent.; sulphur, 0·02 per cent.; silica, 1·56 per cent.; manganese, 0·12 per cent.; lime, trace; total, 100·62; metallic iron constituent, 74·25 per cent. The hematite ore has the following composition:—Peroxide of iron, 96·60 per cent.; lime, 0·10 per cent.; magnesia, 0·30 per cent.; silica, 1·07 per cent.; water, 1·30 per cent.; total, 99·37; metallic iron constituent, 70·00. The steelworks will manufacture Siemens-Martin steel, which will be mostly used in producing railway material, railroads, fencing and telegraph wires.

New Companies.

MEASURES BROTHERS LIMITED.—This company was registered on the 19th inst., with a capital of £100,000, divided into 1000 shares of £100 each, to acquire and take over the business now carried on at 57, Southwark-street, in the county of Surrey, under the style of "Measures Brothers," and to carry on business as iron contractors, girdermakers, bridgemakers, iron merchants, and general engineers. Until otherwise determined by a general meeting, the number of directors is not to be less than 3, nor more than 7; qualification, £2000; remuneration, £3000 per annum. Registered by Messrs. Pritchard, Englefield, and Co., Painters' Hall, E.C.

TAVY IRON AND ENGINEERING COMPANY LIMITED.—This company was registered on the 19th inst., with a capital of £10,000, divided into 2000 shares of £5 each, to adopt and carry into effect a certain agreement, and to carry on the business of mechanical engineers in all its branches, manufacturers and machinists, fitters, carriage and engine makers, wheelwrights, millwrights, plumbers, gas-fitters, boilermakers, electro-platers, and all similar trades. The number of directors is not to be less than 3, nor more than 7; qualification, £100; remuneration, £100. Registered by Sir John Causton and Sons, 9, Eastcheap, E.C.

FEVIGS STEEL AND IRON SHIPBUILDING COMPANY LIMITED.—This company was registered on the 16th inst., with a capital of £30,000, divided into 3000 shares of £10 each, to purchase the shipyard, fixed and loose plant and tools, stock-in-trade, businesses, goodwill, patents, and other assets of Mr. Robert Scrafton, at Fevigs, Norway, carried on as Fevigs Jernskibsbiyggeri; for that purpose to enter into a certain agreement, and to carry on the businesses of shipowners, engineers, and analogous trades. The first directors are to be Messrs. R. Scrafton and J. J. Scrafton; qualification, 100 shares. Registered by Messrs. Jackson and Jackson, 61, Lincoln's Inn Fields, W.C.

NEWPORT ENGINEERING AND SHIP REPAIRING COMPANY LIMITED.—This company was registered on the 7th inst., with a capital of £10,000, divided into 1000 shares of £10 each, to make, build, equip, and repair ships, boats, and vessels of all kinds, and to manufacture and repair marine and stationary engines, boilers, machinery or other appliances; to purchase the business of engineers and ship repairers now carried on by Messrs. T. Dixon (the younger) and T. C. Calder, under the style of the Newport Engineering and Ship Repairing Company. With certain modifications the regulations of Table A apply. Registered by Messrs. Pattison, Wigg and Co., 11, Queen Victoria-street, E.C.

ENGINEERING AND BOILER COMPANY LIMITED.—This company was registered on the 20th inst., with a capital of £15,000, divided into 15,000 shares of £1 each, to purchase or otherwise acquire the businesses now carried on in the city and county of Bristol, Gloucester, or elsewhere, under the style of W. Pope and Co., and Batt and Phillips and to carry on the business of mechanical engineers, boiler and tank makers and repairers, iron and brass founders, and general machinists. The number of directors is not to be less than 3, nor more than 7; qualification, £50 at least; remuneration to be fixed in general meeting. Registered by Messrs. Jordan and Sons, 120, Chancery-lane, W.C. Registered office, 21, Nicholas-street, Bristol.

TINKERS LIMITED.—This company was registered on the 20th inst., with a capital of £50,000, divided into 5000 shares of £10 each, to purchase or otherwise acquire and take over as a going concern the business and goodwill of the business of boilermakers now carried on at the Darsyfield Works, Newton Hyde, Chester, by Messrs. James Tinker and George Tinker, under the style of Tinker Bros.; and to carry on the business of boilermakers, toolmakers, iron masters and foundry shipwrights, electricians, consulting and mechanical engineers, etc. The number of directors is not to be less than 3, nor more than 7; remuneration, an allowance of £10 per cent. per annum on the net profits. Registered by Messrs. Lekiche and Stevens, 23, Roodlane, E.C.

CHILVINGTON TOOL COMPANY LIMITED.—This company was registered on the 17th inst., with a capital of £15,000, divided into 1500 shares of £10 each, to purchase or acquire the business of edge-tool manufacturers, formerly carried on at Wolverhampton, under the style of "The Chillington Tool Company"; to enter into a certain specified agreement, and to carry on in Great Britain, Ireland, or in any other part of the world, all or any of the trades or businesses of manufacturers, merchants of any kind of tools, implements, machines, etc., and founders, workers, smelters, and dealers in iron, steel, and other metals. The number of directors is not to be less than 2, nor more than 5; qualification, 20 shares. Mr. J. W. Hunt, who is to be the first director of the company, is entitled to a salary of £200 a year. Registered by Messrs. Waterlow Bros. and Layton, Birchin-lane, E.C.

W. POPE AND SONS LIMITED.—This company was registered on the 21st inst., with a capital of £12,000, divided into £10 shares, to enter into a certain agreement, and to carry on the trades or businesses of mechanical engineers and manufacturers of all kinds of engineering apparatus, machinery, and appliances, and to undertake any work generally relating to the business of the company. The number of directors is not to be less than 2, nor more than 7; qualification, £100; remuneration to be fixed in general meeting. Registered by Mr. H. Godfray, 60, Finsbury Pavement, E.C., solicitor.

WALSALL ELECTRICAL COMPANY LIMITED.—This company was registered on the 6th inst., with a capital of £10,000, divided into 1000 shares of £10 each, to acquire and take over as a going concern and carry on the business of a manufacturing electrician and electrical engineer now carried on by Mr. Frederick Brown at Walsall, in the county of Warwick, under the style or firm of "The Walsall Electrical Company," and to prosecute the business of electricians, electrical contractors, electrical, mechanical, and general engineers, and founders in brass, iron, or any other metal or alloy. The number of directors is not to be less than 3 nor more than 5; qualification, £250; remuneration, £1 1s. for each board meeting, not to exceed £13 13s. per annum. Registered by Mr. Frederick Needham, 10, New Inn, W.C. Registered office, 57, Bridge street, Walsall.

Trade Marks.

The following is the Official List of Applications published from December 14 to December 21, for the Registration of Trade Marks, so far as relates to the Metal Trades.

CLASS 4.

"The essential particular of the Trade Mark is the device, and the applicant disclaims any right to the exclusive use of the added matter."

167,936. Carbon for electric purposes. WM. GRUDELBACH Dinslaken-on-the-Rhine, Germany; manufacturer.—24th October, 1892. *Address for service in the United Kingdom*, R. Mestern, 50, Tunis-road, Shepherd's Bush, London, W.

CLASS 4.

VULCAN

167,671. Ironfounders' blacking used for metal castings. IRONFOUNDERS' GRINDING COMPANY, 3, West Scotland-street, Glasgow; blacking manufacturers.—12th October, 1892.

CLASS 6.

UNIVERSAL

166,524—2826 S. Boring machines. The HARDY PATENT PICK COMPANY LIMITED, Mining Tool Works, Heeley, near Sheffield; manufacturers.—13th August, 1892. Mark used since four years before 1876.

CLASS 47.

IXION.

167,816. Lubricating oils. GEORGE HATCH Crown Wharf, 5, Upper Thames-street, London, E.C.; engineers' ironmonger.—18th October, 1892.

Official Gazette.

Partnership Dissolved.

J. SHIPMAN, J. W. SHIPMAN, and F. SCHWAB, under the style of J. Shipman and Co., Sheffield, steel and wire manufacturers; as far as regards J. Shipman.

THE BANKRUPTCY ACTS, 1883 AND 1890.

Adjudication.

ISABELLA BROWN, trading as John Brown, South Hylton, near Sunderland, rivet manufacturer.

Letters to the Editor.

*** *We do not hold ourselves responsible for opinions expressed by correspondents.*

*** *The name and address of the writer (not necessarily for publication) must in all cases accompany letters intended for insertion, or containing queries.*

*** *Letters intended for publication in the current week's issue must reach our Manchester Office not later than by the first post on the Tuesday preceding the date of publication.*

RELATIVE SIZES OF BOILERS AND ENGINES.

To the Editor of THE MECHANICAL WORLD.

SIR,—There can be no doubt as to the necessity for some information upon the question raised by your correspondent, "Inquirer." Much haziness exists as to the proportions of engines and boilers, and especially as regards small engines. Engines with cylinders from 5in. to 9in. diameter are often exceedingly extravagant, and will use as much as 50lb. of steam per I.H.P. per hour; while larger engines, compounded, or of modern construction, will use from 15lb. to 20lb. per I.H.P. per hour. The same may be said of vertical boilers; as they vary in construction they will vary in efficiency, consuming anything from 10lb. to 25lb. of coal per square foot of grate area, and such a consumption may evaporate from 5lb. to 8lb. of water per lb of coal consumed. When the indicated horse-power is known to be, say, 80 or upwards, and a modern engine is to give off the power and steam supplied by Cornish or Lancashire boilers, the following notes will be found useful:—The engine requires 20lb. of water (in the form of steam) per indicated horse-power per hour. A boiler will evaporate in all-round working 8lb. of water per lb. of fuel, and with a chimney draught of 0·5in. unbalanced water column, will consume 20lb. of coal per square foot of grate per hour, with the heating surface and grate area as 25 to 1. These are from all-round practice, but all may vary slightly; for instance, with a very high pressure a less weight of steam may be used, with a very good coal more water will be evaporated, and with a very strong chimney draught more coal would be consumed.

With small engines and vertical boilers experience must dictate, as it is seldom known what power is developed.

Manchester, Dec. 27. RIVET.

A GOOD EXAMPLE.

To the Editor of THE MECHANICAL WORLD.

SIR,—As a reader of THE MECHANICAL WORLD, I write to inform you of a plan adopted last week of freeing myself of the ever-increasing pile of your paper (from which I have taken many notes), and, at the same time, to introduce it to non-readers.

I placed the year's issues during the dinner hour at the entrance to our works (a machine shop), with a note inviting the men as they came in to take one. They were soon all gone, I assure you.

As a young engineer, I may say I have benefited greatly by the perusal of THE MECHANICAL WORLD. H. BINNS.

Keighley, Dec. 20.

HINTS TO YOUNG DRAUGHTSMEN.

To the Editor of THE MECHANICAL WORLD.

SIR,—In reply to J. Nichols's friendly criticism, I would say that I recommend a half set of compasses for a beginner, because a much greater range of work can be accomplished by their use than with bow, pen, and pencil. However, when economy has to be studied, a set of pillar (pocket) compasses should be bought. The price ranges from 12s. to £2 2s., according to quality. The writer used nothing else during his first year, and as they combine pen and pencil compasses, dividers, and pen and pencil bow, their range of usefulness is very large.

I am not in any way interested in the sale of instruments. Had I been I should not have proposed such searching tests of quality—tests which have proved defective the instruments of leading makers.

The prices quoted are what I have paid myself, and are copied from the lists of well-known London firms.

To "S. H." (December 16) I hope to be able shortly, with the Editor's permission, to furnish sketches of nut and thread gauges. A written description would not be intelligible. Copy book of the German round writing (Söennecken's) may be had from Quintain Hogg, Paternoster row, London, price 2s. 6d.; assorted pens, 1s. a box. THE WRITER OF THE ARTICLE.

Lisbon, Dec. 20.

AMERICAN AND BRITISH WORKMEN AND MACHINERY.

To the Editor of THE MECHANICAL WORLD.

SIR,—I read with interest the paper by Mr. Arthur, which appeared in THE MECHANICAL WORLD of December 9.

By your permission I would like to give my humble opinion of the latter portion of the above paper. I shall pass over the first half, where he speaks about locomotive building, as I have had no experience in that class of work.

I have worked in America eight years, and I have worked in many shops in all parts of this country in the engineering trade, and on all kinds of machinery. I have always taken a keen interest in tools and methods for doing work with the least amount of physical force. I know from experience in the use of American and English tools that the American toolmakers study the physical energy of the workman more than the British toolmakers do. This is especially so in lathe construction; the American lathe bed has V's planed on the top surface for the carriage to travel on, which reduces the friction to a minimum, and makes it easier to work by hand. Moreover, you do not require such heavy gears for screw cutting as you do with the English lathe bed. The American lathe carriage cannot wear loose sideways, it can only wear the V's lower from the lathe centre.

Take, for example, an English lathe bed with its flat wearing surface; we will say it is 12in. centres, and with a bed 20ft. long. Suppose it is used mostly on short work, the bed will wear mostly at that end. You tighten up the jibs to take up the wear. Then you get a long shaft to turn and screw-cut the full length of lathe bed. You soon find that you cannot move the carriage to the other end, as required, without loosing the jibs.

I pity the man who has that screw to cut, necessitating such an expenditure of physical energy to drag the carriage to the other end every time he takes a fresh cut. The American lathe carriage does not require more than half the energy to move it about; therefore, you must be able to turn out more work in a given time with less exertion. I am confident that if our tool makers, or our employers, had to work both kinds of lathes, as I have done, they would abandon our flat-surface lathe beds. One would think the feed motions of some of our lathes were intended to drive a mill. Then, again, look at the time lost in changing these heavy gears. Mr. Arthur is right where he says the poor British workman is loaded by everything he has to move; he has, therefore, to use more force, and his motions are more clumsy and slow. He also says: "The prevalence of noise and jar in British machinery is amazing," which is also very true.

He speaks of the dirty British workman. I wish to say here that all workshops in America are provided with large sinks for the men to wash themselves in before they leave work. On that account, the American workman has a more respectable appearance on the street than the British workman. I wish we had the same provision in our workshops. Cleanliness is next to godliness, and it all tends to a higher civilisation. Without going into any more details, I wish to say this about the last half of Mr. Arthur's paper: We can allow a little discount for his national pride and boast, and still have a good margin left that we can profit by if we only try. Having worked in both countries, I can assure you that there is more truth than boast in Mr. Arthur's impression of British workshops and workmen. J. N.

Stockton-on-Tees, Dec. 19.

Prize Competition.

WE OFFER FOUR GUINEAS MONTHLY IN PRIZES FOR THE BEST ORIGINAL ARTICLES SENT IN ON ANY MECHANICAL, ENGINEERING OR ELECTRICAL SUBJECT.

IN ORDER THAT MANAGERS, DRAUGHTSMEN, FOREMEN, AND WORKMEN WHO HAVE HAD NO PRACTICE IN WRITING MAY NOT HESITATE TO SEND IN COMPETITIONS, IT IS TO BE UNDERSTOOD THAT ALL ARTICLES WILL BE FULLY EDITED AND CORRECTED, AND JUDGED OF SOLELY ON THEIR MERITS AS ORIGINAL CONTRIBUTIONS FROM A PRACTICAL POINT OF VIEW. THE OBJECT OF THE COMPETITION IS TO INDUCE PRACTICAL MEN TO COME FORWARD AND GIVE THE RESULTS OF THEIR EXPERIENCE.

CONDITIONS.

Competitions for our Monthly Prizes must be sent so as to arrive at the Manchester Offices of THE MECHANICAL WORLD, New Bridge-street, not later than the last Tuesday in each month. Articles arriving after that time will be placed in the following month's competition.

Written competitions must be on one side of the paper only. The contributions must be original, and relate to matters connected with Engineering, Mechanism or Electricity.

The Proprietors of THE MECHANICAL WORLD reserve the right to publish any competition, whether it gains a prize or not.

The competitions may be accompanied by diagrams, sketches or drawings.

Competitors should write the words "Prize Competition" on the envelopes.

Competitors are not confined to one, but may send any number of competitions.

The correct name and address of the sender *must* be distinctly written upon every competition, not necessarily for publication. Competitions can appear under a *nom de plume*.

☞ We cannot undertake to be responsible for any MSS. sent to us, though when stamps are enclosed for the purpose we will endeavour to return rejected contributions.

Miscellaneous Items.

Electric heaters are being tried experimentally on several electric street railroads in New England.

As an experiment, one section of the propeller shaft of the United States warship "Brooklyn" is to be made of nickel steel.

The elevated railroad which runs along the line of docks at Liverpool is to be opened on February 4 next. The Marquis of Salisbury has accepted an invitation of the directors to perform the inaugural ceremony.

Statistics on the zone tariff system in force on the Hungarian railways show that since this came into operation the annual nnmber of travellers has risen from 6,000,000 to 28 000,000, and the receipts from 9,705,000 florins to 23,300,000.

In consequence of representations by the Royal Commission on Labour against the systematic employment of men on overtime at Chatham Dockyard, the Admiralty on the 22nd inst. issued an order that overtime in all departments should cease from the 23rd inst.

At the Royal Agricultural Show to be held at Chester next June, prizes of £100 for self-binding harvesters, £30 for sheep-shearing machines, and £32 for horse shoeing competitions, will be offered. The entries for the exhibition of implements, etc., close on April 1, 1893.

It is announced that envelopes in two sizes for circulars and other matter transmissible by post at the book rate, bearing an embossed postage stamp of the value of a ½d., will be on sale at every post office on and after the 1st January. The price will be—commercial size, 5½d. for 10; foolscap size, 6d. for 10.

The inauguration of the Corinth Canal has been fixed for the 23rd April next. According to the conditions of the contract, the works were to be finished in May next; but efforts are to be made to hurry forward the works in order that the inauguration ceremony may take place on the date named. As soon as the canal is open for navigation the Messageries Company will, it is stated, be the first to establish a line of steamers to Patras and other ports of Greece.

In order to ascertain whether petroleum might safely be used in torpedo boats as fuel, some interesting experiments have just taken place at sea, near Toulon. Ten cases filled with petroleum, protected by a sheet of iron or metal plates similar to the sides of a torpedo boat, were placed on a raft. A quick-firing gun of 1·83 inch calibre, placed on a floating pontoon moored 100 metres distant, fired twelve shots at the plate, the result being that eight of the cases ignited. Probably this trial will be decisive as against using mineral oil as fuel for torpedo boats.

The novel feat of obtaining perfectly cylindrical cores of rock formations overlain by over 100ft. of water has recently been accomplished in obtaining data for the new tunnel between Prince Edward Island and New Brunswick, under the Straits of Northumberland. A diamond drill driven by steam at the rate of 1000 revolutions a minute is attached to an iron tripod resting on the bottom of the sea and secured in its position by anchors. The steam was conveyed to the drill in flexible pipes from a scow on which are placed the boilers, and which is anchored alongside.

The working days of different nations forms the subject of some interesting data just published by a Polish statistician. The names of the countries enumerated, with the number of their statutory working days, are thus given:—Interior Russia, 267; Canada, 278; Scotland, 275; England, 278; Portugal, 283; Russian Poland, 288; Spain, 290; Austria and the Russian Baltic Provinces, 295; Italy, 298; Bavaria, Belgium, Brazil, and Luxembourg, 300; Saxony, France, Finland, Wurtemberg, Switzerland, Denmark, and Norway, 302; Sweden, 304; Prussia and Ireland, 305; United States, 306; Holland, 308; and Hungary, 312.

The North Belgian Company and the Northern of France Company have for some time past been constructing a new line for locomotive engines worked by electricity. The new train will consist of four carriages and two vans, and it will begin running in less than two months from the present time. Fares, so far from being increased, are to be reduced. Leaving Charleroi, in Belgium, at 10 in the morning, the traveller will arrive in Paris at 12-50, and on the return journey he will leave Paris at 6 in the evening in order to arrive at Charleroi at 8-50. The distance between the French and Belgian capitals is 192½ miles.

A handsome medal has been struck for the Edinburgh College of Science and Technology, the expense of the die being borne by the Right Hon. the Earl of Rosebery, K.G., LL.D. On the obverse, representations appear of the Forth Bridge, a North British express locomotive, a Bessemer converter, dynamo, theodolite, sextant, etc., surrounding a female figure, typical of science. The motto is "Palman qui meruit ferat." On the reverse there is a scroll, in laurel leaves, bearing the word "Perseverando," a wide margin being left for the engraving of the names of fortunate winners of the medal. The die was designed by Messrs. Alex. Kirkwood and Sons, of Edinburgh, under the superintendence of Mr. J. Gibson Fairweather, B.Sc., C.E., Director of the College.

It has now been definitely decided to commence to run the electric cars on the tramways to Wednesbury, James Bridge, and Walsall, on the first Monday in the New Year.

The Italian Minister of Marine has decided to make a series of trials with German steam coal, with a view to its general use in Italian warships instead of English coal. The Germans claim that their coal is cheaper and better for ships' use than English.

Electric lighting is to be adopted in twenty passenger carriages on the Kaiser Ferdinands North Railway running between Vienna and Podwoloczyska, as a result of some recent successful trials. The carriages will be lighted by 6C.P. lamps. The lighting will be done by means of a battery of accumulators, and the carriages are to be ready to be put in operation by the end of March next.

One of the most remarkable of trees or shrubs grows near some springs about twelve miles north of Tuscarora. It is about six or seven feet high, with a trunk which at its base is three times the size of an ordinary man's wrist. It has numberless branches and twigs, and resembles somewhat the barberry. Its wonderful characteristic is its luminosity, which is so great that on the darkest night it can be plainly seen a mile away. Its foliage is extremely rank, and its leaves resemble somewhat those of the aromatic bay tree in shape, size, and colour. The luminous property is due to a gummy substance, which can be transferred to the hand by rubbing, and with the transfer the phosphorescent light, while that on the leaf disappears. This luminosity is thought to be due to a parasitic form.

Queries.

☞ Readers are invited to avail themselves of this section for practical information on questions relating to Mechanical Engineering and the Scientific Industries.

☞ Queries and Replies should arrive at the Manchester Office not later than by the first post on the Tuesday preceding the date of publication.

PLOUGH BREASTS.—Can any reader inform me the best way to grind cast-iron plough breasts? —T. W.

POOLE'S GRINDING MACHINE FOR LATHES.—Required, the address of makers of this machine.

SWEDISH BESSEMER STEEL.—Can any reader inform me how Swedish Bessemer steel is made, and also give highest amount of carbon it contains?—FORGEMAN.

FRENCH AND ENGLISH WEIGHTS.—Can any reader inform me of a work converting tables of weights of millimetres into English pounds per metre run?—ANGLO-METRIC.

COATING FOR WATER PIPES.—Can any reader tell me how to ascertain whether cast-iron pipes have been properly coated with Dr. Smith's solution?—WATER PIPE.

BLUE PRINTING.—Can any reader kindly inform me what the necessary mixture for *extra rapid* ferro-prussiate sensitising fluid is made from, and the quantities?—FOUNDRY.

SPEED OF LOCOMOTIVES.—Provided a railway line is laid as perfect as possible, can any engine attain such a velocity as to cause it to leave the rails owing to excessive speed only?—P. T. G.

IRON MIXTURE.—Would "Foreman Pattern Maker" kindly inform me whether his mixture for chilled hammer heads would do for chilled rolls; if not, would he kindly give one?—MOULDER.

TWIST DRILL CUTTERS.—Can any reader give me a method of getting the correct thickness and shape of cutter for any diameter of twist drill, straight lip? A drawing will greatly oblige.—J. M. F.

"GRASS" PACKING.—Can any reader supply me with the address of manufacturers of this packing? I have seen it used for the piston and valve rods of L. and N.-W. railway engines.—LOCO.

HEATING FACTORIES BY AIR.—Can any reader inform me of any satisfactory system of heating a large factory by heated atmospheric air, and with what result? Also the address of the makers of the apparatus.—H. W. (Germany).

PETROLEUM.—Will any chemical correspondent kindly inform me what is the chemical constituent in petroleum that causes it generally to give off such an objectionable odour, and also by what means it is deodorised?—ODOUR.

PRESSED PAPER.—I shall be obliged if any reader can furnish me with names of firms in England or abroad who press paper for making trays, wheels, teeth, etc., and the widening circle of articles now made of compressed paper or pulp.—A CONSTANT READER.

GRINDING VALVES.—Will any reader advise me as to the best means of scouring brass valves and seats to a smooth face? I have tried flour emery, and a fast speed, but as I get at times different mixtures of metal in the valve and seat, I cannot smooth them both together.—W. THOMAS.

TUBE MANDRELS.—Can any reader inform me the best way to steady while turning, and also to lap when turned, a mandrel $1\frac{1}{16}$in. × 7ft. long, to be lapped with $\frac{1}{1000}$ of taper in the whole length? I should also like to know the price per foot for the same.—TURNER.

LOSSES IN STEEL FURNACES.—Could any reader kindly inform me the average per cent. of actual loss, and the average per cent. of skull, in the charge of a Siemens open-hearth steel furnace working charges of from 30 to 40 tons? And also the percentage of loss in heating slabs and ingots in the Siemens regenerative gas furnace?—J. R. R.

THREE-THROW PUMP.—A three throw single-acting pump has barrels $4\frac{1}{2}$in. bore; 14in. stroke runs at 25 revolutions per minute. It has 3in. delivery 35ft. high; suction pipe, 10ft. high; 230ft. horizontal length, with three bends. Would 3in. suction pipe be large enough to allow pumps to work to their full capacity?—F. C.

FILTRATION.—Will any reader state the best method of filtering 150 gallons of canal water per day for steam-boiler purposes?—T. H. MITCHELL.

WINDING ENGINE.—What weight would a pair of 36in. cylinder engines by 4½ft. stroke raise from a pit with a spiral drum, commencing at 14ft. and finishing at 18ft. diameter, one side to wind from a depth of 350yds. and the other side from 400yds.; ropes to be 1¼in. diameter, boiler pressure 80lb. per square inch, cut-off at ⅔ stroke? What weight would the above engines raise from a depth of 280yds., with a flat rope drum, commencing at 12ft. diameter; sizes of ropes 5½in. by ⅝in. (steel)? What would be the rise in inches per yard of a slant whose angle is 26 degrees?—MINER.

SUGAR MILL ROLLS.—Will the writer of the article on sugar machinery or some other practical man say what is considered the best pitch angle and depth of grooves for front, top, and megass rolls, 30in. × 54in. second mill double crushing plant. What causes the juice to squirt out between top and megass rolls of the second mill? I have been told it is caused by hollow places; but in this case I am doubtful, as the rolls have no hollow places that I can see or feel by calipering. I think the distance between top roll and trash turner plate has something to do with the squirting, but opinions differ greatly.—SUGAR MILL (North Queensland).

WHEELS FOR MILLING MACHINES.—I thank "I.H.P." for his answer. The machine is a universal milling machine with a spiral head. The tangent wheel has 40 teeth, the worm has a single thread. The feed screw has four threads per inch on one, and five per inch on the other. I want to know if there is a standard number to work my own change gears out for wheels, gears, or anything I may want. I would also like to know how to find the angle of a spiral by calculations. "I. H. P." says there are two small hand-books—one by E. Holden and the other by J. Broadley. Will he tell me which he thinks is the best of the two, and the price?—TOOLS.

Replies.

☞ Owing to the constant increase in our correspondence, we regret that we have no alternative but to announce that we cannot reply by post to Queries even when stamped envelopes are sent.

☞ Queries and Replies must in all cases be accompanied by the names and addresses of the writers, as no notice will be taken of anonymous communications.

J. P. R.—No address is given.

DUDLEY HILL READER.—Presuming both pumps run at the same speed, that with the 5in. ram pumping into the cistern would require 50 per cent. more power.

S. W.—So far as we understand your query, any book giving circumferences of circles would suit you—the "Mechanical World Pocket Diary," for instance.

LATHE.—We cannot say if a machine of the kind has already been invented. Only a thorough search through the patent specifications will enable this point to be settled.

VERTICAL BOILER.—We would advise you to consult Hasluck's "Model Engineer's Handybook." Such queries cannot be answered satisfactorily in the space available, and they would only interest a very small section of readers.

H. RANSON.—You will find a rubber-faced pulley answers best, if no very large amount of power is to be transmitted. We do not see how you are to devise a motion to do all that you require. Would not a crank motion answer instead?

A. B. C.—The rule given is no doubt intended to be applied to marine boilers. To obtain the proportion for other types you must divide the average rate of combustion per foot of grate by the lb. of steam required to develop 1 I.H.P. in the particular classes of engines. You will find a table of rates of combustion of fuel in boilers in the "Mechanical World Pocket Diary" for 1893 (p. 92).

TRIPLE-EXPANSION ENGINE CYLINDERS.—Will any reader show me how to find the diameters of the H.P. and M.P. cylinders, from the following data:—Diameter of L.P. cylinder, 88in.; stroke, 5ft.; revolutions, 73; boiler pressure, 180lb.; 4500 I.H.P.; cut-off in H.P. cylinder, 0·6 stroke.—W.G.——4.—In the calculation and summation of horse-power in last column of page 249, my copy seems to have been misinterpreted. The "I.H.P." to right of column, 17 lines from end of answer, is the heading to a column of figures, thus:—

	I.H.P.
H.P. of H.P. cylinder	486·14
,, M.P. ,, ...	1386·10
,, L.P. ,, ...	1715·40
Total.....	3537·64

—T. J. B.

Latest Inventions.

APPLICATIONS FOR LETTERS PATENT.

When Patents have been "communicated," the name of the communicating party is printed in italics.

Where complete specification accompanies application, an asterisk is suffixed.

12th December, 1892.

22,766 INTERCEPTING and SEPARATING SOLID from LIQUID SEWAGE. T Brown.

22,770 STEAM BOILER and OTHER FURNACES and GAS PRODUCERS. A McInnes.

22,776 SAFETY LOCKING of RAILWAY HOME SIGNALS. R Wilson.

22,778 GALVANISING IRON. R A Carrasco.

22,785 STEAM MOULDING and CONE-MAKING MACHINE. J Shepherd.

22,786 FORCED and INDUCED DRAUGHT ARRANGEMENTS. J Williamson and J Black.

22,787 TUBE PLATES for STEAM BOILERS. J Williamson and J Black.

22,790 CRANES. J Marshall and others.

22,791 SIGNALLING on TRAINS. A Shiels.

22,796 CAST STEEL JARS for ROCK-BORING INSTRUMENTS. D Thubron.

22,797 GEAR for TRANSMITTING and REVERSING the POWER GIVEN OFF by GAS and OIL ENGINES. J E Weyman and others.

22,812 MULTIPLE STEAM or OTHER MOTIVE POWER ENGINES. J W Restler.

22,818 METHOD of STARTING GAS or OIL ENGINES. F W Crossley.

22,822 DUST-COLLECTING APPARATUS. T and G M Parkinson.

22,824 RAILWAY SIGNALLING APPARATUS. C Mackintosh.

22,826 ELECTRIC ACCUMULATORS. W P Thompson. (*The Süddeutsche Elektricitäts-Gesellschaft, Raab and Bastians, Commandit Gesellschaft*, Germany.)

22,837 COMBINED KNOCKER and ELECTRIC BELL CONTACT. G S Hooker.

22,838 LONG-DISTANCE TELEPHONES.* C A Day. (*C M Haynes*, United States.)

22,842 GIRDERS. A Thrower.

22,843 APPLICATION of ALUMINIUM. W R Taylor.

22,848 LAMP for SOLDERING. J Geiser.

22,849 SHEET METAL HOOKS. H H Lake. (*H E Kelley*, United States.)

22,850 COCKS and VALVES. J Price and others.

22,854 ELECTRIC ARC LAMP. H Pidot. (*P Archat*, France.)

22,855 GAS METERS. F C Bellamy.

13th December, 1892.

22,857 BORING MACHINE for DRILLING HOLES in MARINE ENGINE SHAFT COUPLINGS. W L McKay.

22,858 ELECTRIC ARC LAMP. G Davenport.

22,860 PIPE COUPLINGS for RAILWAY VEHICLES. J Dewrance.

22,864 REVERSING GEAR of DIRECT-ACTION PUMPS. W Cadman.

22,869 TOOL HOLDERS of LATHES. W Asquith.

22,872 VALVES for CONTROLLING and UTILISING SURPLUS STEAM. G Cockburn and A W Baird.

22,874 MOTIVE POWER ENGINE. W G Dawkins.

22,886 CHUCKS EMPLOYED in LATHES. A Roberts, jun.

22,889 ELECTRICAL FITTINGS. A Firth and G Y Ashwell.

22,903 APPARATUS for AUTOMATICALLY ACTUATING RAILWAY SIGNALS and SWITCHES. T Marsden and I Thompson.

22,904 ENGINE for DRIVING PORTABLE DRILLING MACHINES. C H Stocks.

22,913 DREDGING APPARATUS. J Gwynne.

22,918 APPARATUS for COLLECTING and SEPARATING DUST, ETC., from AIR or OTHER GASES. E Stubley and J H Goodall.

22,919 APPARATUS for SEPARATING DUST, ETC., from AIR or OTHER GASES. P van Gelder.

22,921 SIGNALLING to a CENTRAL POINT or STATION. W P Thompson. (*L Anspach*, Belgium.)

22,923 ELECTRIC CABLES. S Z de Ferranti.

22,925 LONG-DISTANCE TELEPHONIC TRANSMITTERS OF and RECEIVERS OF SOUND. R H E Courtenay.

22,929 TWIST DRILL GRINDING DEVICES.* J H Bergstrom.

22,933 TOOLS for the MANUFACTURE of the BUFFER RODS of the BUFFERS of RAILWAY and TRAM VEHICLES. W Somers.

22,938 BRAKE. J B Dunlop.

22,939 SCREW-CUTTING LATHES. F Lamplough.

22,947 UTILISING WASTE ENERGY in WATER SUPPLY SYSTEMS for GENERATING ELECTRICITY. W Lowrie.

22,951 SWITCHBOARDS for USE in the DISTRIBUTION of ELECTRICAL ENERGY. R E B Crompton.

22,955 BALANCED SLIDE VALVE. A M Clark. (*J Parker*, Canada.)

22,967 WIND MOTOR. F H Medhurst.

14th December, 1892.

22,971 APPARATUS for SCREENING and DELIVERING COAL. J Ellis and C McHardy.

22,987 SECONDARY BATTERY PLATES.* P M Justice. (*W W Griscom*, United States.)

22,990 METALLIC PACKING.* G Garnett.

22,997 ANTI-FRICTION COMPOUND for MAKING BEARINGS and PACKING, ETC. H F Höveler.

23,003 ANTI-FRICTION METAL. J Downie. (*T Downie*, Italy.)

23,004 TRANSMISSION of ROTARY MOTION and POWER. B C Tilghman.

23,007. GALVANIC BATTERIES. W Walker and F R Wilkins.

23,008 GAS or OIL MOTOR ENGINES. J Fielding.

23,012 BEARINGS for the AXLES of RAILWAY VEHICLES. J Berkley.

23,017 PRESSURE GAUGES for COMPRESSED GASES. J Jackson and E A Hoad.

23,022 LOUD-SPEAKING TELEPHONE. A Graham.

23,023 SYSTEM of TELEPHONIC NEWS TRANSMITTER. T Puskas.

23,027 REFRIGERATORS. E Willows.

23,029 TAIL SHAFTS and STERN BUSHES for SCREW STEAMERS. A Gladstone.

23,033 WORK-HOLDING LATHE CHUCK. G A Gervais and others.

23,035 DRIVING CLUTCH. G A Chaddock.

23,039 ELECTRICAL CONNECTIONS for SUPPLYING CURRENT to ELECTRIC MOTORS. W von Winkler and J Fekl.

23,044 FURNACES for STEAM BOILERS, ETC. W O Wood and C Burnett.

23,045 APPLICATION of AIR BLAST to the RAISING, CONVEYING, and SORTING of COAL. W O Wood and C Burnett.

15th December, 1892.

23,057 FITTINGS for USE in ELECTRIC LIGHT INSTALLATIONS. F King and W P Mendham.

23,058 FOG SIGNALLING. J H Pinder.

23,061 PORTABLE ELECTRIC LAMP FITTINGS. W H Sturge.

23,062 PROCESSES of HARDENING and TEMPERING STEEL WIRE. J Moseley.

23,068 MECHANICAL and ELECTRICAL INTERLOCKING of RAILWAY SIGNALS, ETC. A Ross and others.

23,086 COMMUNICATING by TELEPHONE BETWEEN SEVERAL STATIONS.* R D Smillie.

23,089 SEPARATION of DUST from AIR. T and G M Parkinson.

23,091 PROPELLERS. G O Wallace.

23,097 ROTARY ENGINES. H H Lake. (*H K Wheeler*, United States.)

23,107 GUIDING and PROPELLING APPLIANCE for AERIAL NAVIGATION. A Pflueger.

23,112 MACHINERY for ROLLING METAL. Société Anonyme des Aciéries de Longwy.

23,117 STEAM PRESSURE VALVES.* C Richards.

23,113 APPARATUS for DETERMINING DIFFERENCES BETWEEN the PHASES of TWO ELECTRIC ALTERNATING CURRENTS of LIKE NUMBER of ALTERNATIONS.* M von Dolivo-Dobrowolsky, and the Co. Allgemeine Elektricitäts Gesellschaft.

Manuscript Specifications of Patents can be examined at the Patent Office, London, after the Complete Specification has been accepted, on payment of 1s. The printed Specifications are usually published in about one month after acceptance of the Complete Specification, and any single copy may be obtained by remitting 8d. in stamps (or by special post cards sold at the Post Offices at 3d. each) to SIR H. READER LACK, *Comptroller General, Patent Office, 25, Southampton Buildings, Chancery-lane, London. When a number of Specifications are required, remittances may be made by P.O.O.*

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AND

YEAR BOOK FOR 1893.

SIXTH YEAR OF PUBLICATION.

A handy Pocket Book, containing a Calendar of Engineering Events, etc., Useful Tables, Diary, together with a Collection of Notes and Formulæ, specially compiled for the use of Engineers, Draughtsmen, Mechanics, Students, Manufacturers, and others.

This Issue will be found to contain a large amount of new matter of a thoroughly practical character. The section on Steam and the Steam Engine has again been extended, and now embraces Notes on Expansion of Steam, Clearance, Diagram Factors, Compression and Cushioning, Steam and Exhaust Pipe and Port Areas, Lead, Valve Setting, Valve Diagrams, Cylinder Ratios, Fly Wheels, etc.; several new Tables and Illustrations are included in this section. The section on Engine Construction has been amplified by the addition of several Tables, etc., while the portion of the work dealing with Boiler Construction has been almost entirely rewritten and much enlarged. The work also includes Tables and Data on the Strength of Rolled Iron Joists, Horse-power of Belting, Notes on Rope Driving, Horse-power of Cotton Driving Ropes, Notes on Wheel Gearing, Table of Wheel-gearing Constants, Strength of Shafting, Couplings, Plummer Blocks, Dimensions of Brass Plug Cocks, Hydraulic Notes, Hydraulic Cylinders, Worthington Pump Formulæ, Dimensions of Keys and Thrust Collars, Whitworth Bolts and Nuts, Delivery by Pumps, Weight of Pipes (Cast-iron, Wrought-iron, Brass, Copper, Lead, etc.), Cast-iron Balls, and a number of Notes and Tables of a useful character. A 53 Hours' Wages Table is also included.

OPINIONS OF THE PRESS.

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